INCIDENT COMMUNICATIONS STUDY

Large Fire Radio Communications
Systems and Related Support Elements

REPORT AND ACTION PLAN

May, 1987

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Subject: Incident Communications Study Report and Action Plan

To: Deputy Chiefs, Regional Foresters, Station Directors, and Area Director

The enclosed report and action plan address the design, configuration, procurement, and management of radio communications systems for fire and other emergency incidents. This was an indepth study with team members representing the State of Montana, NFS, CS&T, PSW and BLM.

I commend the study team for its expertise and commitment to the project, and I endorse the recommendations as presented in the report. The team's accomplishments will continue to strengthen the communications capabilities of the Forest Service and our cooperating agencies which are so important for efficient and effective incident management.

F. Dale Robertson

F. DALE ROBERTSON
Chief

Enclosures

INCIDENT COMMUNICATIONS STUDY

Large Fire Radio Communications Systems and Related Support Elements

An Interagency Effort to Examine Large Fire Communications Systems and Related Support Elements

REPORT AND ACTION PLAN

May 1987

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PART I

INTRODUCTION

INTRODUCTION:

The current communications systems design and management in support of fires and other emergency incidents, in which the Forest Service is involved, is based on a 1972 study of Forest Service Telecommunications. The objectives of this study were stated in the Summary, Volume I, as follows:

1. Evaluate the management of the radio systems needed to satisfy the communication requirements of present and future Forest Service programs.

2. Provide methodologies and recommendations for evaluating requirements, financing procedures and organizational structures for electronics and communications management, taking into account alternative non-radio communications systems.

3. Provide solutions to some critical large-fire communications problems.

The study comprised four Volumes, as follows:

Volume I: Summary.

Volume II: Methodologies and Procedures for Evaluating Requirements.

Volume III: Telecommunications Planning, Organization, Financing, and Management.

Volume IV: Design of Large Fire Communication Systems and Analysis of Requirements.

Volume IV was principally concerned with communication needs during fires which had grown to project size or during multiple fire situations. The study also dealt with initial attack situations and air communications. Emphasis was placed on building and maintaining adequate forest communications systems capable of providing the necessary response times to halt fires before they attained unmanageable proportions. The current forest Nets are the outgrowth of this emphasis.

The major impact of this aspect of the study was the development and implementation of the National Radio Cache, currently maintained at the Boise Interagency Fire Center. The Cache system was built around two ground communication networks, one labled Command and the other Tactical. The Command network served Division Boss and above in the Large Fire Organization with three channels with repeater capability. The Tactical network consisted of three single frequency channels with no repeaters.

The cache also provided a Service Net for communication to the "outside world" when telephone service was unavailable, and provisions for intra-camp communications. Fifteen such radio cache systems were built and maintained to support large fires managed by the Forest Service and its cooperators. Similar systems were built and maintained by the Bureau of Land Management at BIFC.

This cache system provided the backbone of large fire communications through the 70's and early 80's and was a vast improvement over previous efforts. The three frequencies allowed for separation of radio traffic, preventing interference between two fires in close proximity. Prepositioning of the caches speeded up installation time, and radio traffic congestion was reduced. Major fires in 1977 in California and throughout the Western United States in 1985 would have been chaotic to manage without the BIFC Caches, and the concept paid for itself many times over in the last 14 years.

Since the inception of the National Radio Cache, communications technology has expanded. Multi-channel personal portable radios, with synthesized frequencies which allow reprogramming are available. Satellites are being used for telephone links to remote areas. Mobile radios are available with sufficient channel capacity to permit preprogamming of all fire channels in use by the Forest Service and its cooperators. Field units in the Forest Service were purchasing equipment with more electronic capacity than hardware in the cache, but found that it was not always compatible with the cache. Often, crews would arrive at an incident and be forced to put away their assigned Personal Portables and check out a cache radio in order to communicate with other personnel on the incident.

The national adoption of the National Interagency Incident Management System (NIIMS) and its Incident Command System (ICS) led to a common organization among wildfire suppression agencies of a local, state, and Federal nature. Interagency communication on incidents became more important, and the cache did not always respond to that need. It was time to reexamine the applicability and responsiveness of the 1972 Telecommunications Study, which was more than ten years old.

The Directors of Aviation and Fire Management, at their 1983 meeting in Albuquerque, addressed the need to validate the applicability of the 1972 National Telecommunications Study. A Study Group explored three primary areas of concern: Radio frequency management-including the emergence of progammable radios with synthesized frequencies, and the expanded opportunities they offered for better utilization of assigned frequencies-was addressed; data transmission between the Incident Command Post at the fire and the outside world was handicapped when adequate phone lines were not available; infrared mapping capability was increasing, and required down-link capability to increase utilization.

The Directors accepted the challenge and urged the Chief to charter an interagency task group to verify the need to update the 1972 Study and develop a study plan. With two 7220 letters dated March 12 and April 16, 1984, the Director of Aviation and Fire Management, WO, chartered such a group. The group met in May 1984 at the Boise Interagency Fire Center. The documentation of that meeting and their recommendations to the Chief are found in the Appendix, Item A. That document states some objectives and constraints for an update of the 1972 Study, describes some expected outputs, and suggested the composition of a Task Force to accomplish the task.

With the 7220 letter of December 11, 1984, the Director of A&FM, WO, agreed with the group's assessment and activated a Study Team to provide the update. Composition of the Study Team is found later in the Introduction, Item D.

The Study Group met in Washington D.C. in March, 1985 to begin its task and documented the scope, objectives, depth and elements of the study as follows:

A: SCOPE OF STUDY

The study is interagency in composition, although its major thrust is to provide direction to the Forest Service for Service-wide National Forest applications. It must address compatibility with Federal, state, and local cooperators, as well as compatability among National Forest users. The study must be done in close consultation with the Department of Interior, and the National Association of State Foresters. That concept was reinforced with the inclusion of representatives of the Montana Forestry Division and Bureau of Land Management on the Study Team.

B. OBJECTIVES

The primary objective of the Study Group is to recommend the design, configuration, procurement and management of a communications system to support fire incidents from initial attack through project fires.

A secondary objective is to develop the capacity to support all risk incidents, such as volcanos, earthquakes, and major hazardous material spills.

C. DEPTH OF STUDY

The inital effort will consist of reviewing the performance characteristics of existing telecommunications systems supporting fire incidents from initial attack to large fires, in both complex and low intensity areas of fire occurrence.

The next phase will involve the validation of continuing needs, as established in the 1972 Study. Considerable detail went into sizing the National Cache and local forest radio needs, through computation and analysis of radio traffic volumes and patterns of use.

The final phase consists of determining how technological advances in electronics can contribute to meeting the needs of the systems being considered. This could involve the consideration of the potential applications of multichannel, programmable synthesized radios for National Forest and cache use, and two-way data communications to remote sites without telephone service using packet radios or satellites. The application of microwave systems being incorporated into National Forest communications systems, along with available telephone service will be examined. Satellite use as repeaters, as well as telephone links is expanding and needs to be researched.

D. STUDY TEAM COMPOSITION

Considerable thought was given to the composition of the Study Team by the WO. Both State Division of Forestry and Department of Interior members were included. Gideon Schwarzbart, Study Leader of the 1972 effort, was included to provide continuity and management expertise to the Team. Both the BLM and Forest Service Fire Caches were potentially impacted, and the managers of both agencies' radio caches were included. Someone familiar with frequency management on a National basis was essential. The final Study Team was configured as follows:

Incident Communications Study Team

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E. ELEMENTS OF STUDY

The 1972 Study addressed several requirements for communications systems that supported large incidents, directly or indirectly. These are grouped into five logical systems, each with specific elements, defined as follows:

1. Command/Tactical Communications Nets. These systems are the critical portion of the National Radio Cache which provides for emergency communication on the incident. The system elements identified in the 1972 Study are as follows:

a. Command Communications - This links Operations and Command functions with each other, the Incident Command Post, and various camps on the incident. The utilization is designed not to exceed 20 stations. Separation is provided to allow for three frequencies, C-1, C-2, and C-3 with repeater links.

b. Tactical Communications - This provides for communication on the fireline, with three frequencies, T-1, T-2, and T-3. Since this usually involves short-range communications beween resources, no repeater capability is provided.

2. Service Net - This net provides short-range, intra-camp communications between Sections, such as Plans, Logistics and Finance. It also provides communication within a Section, such as Logistics, Supply and Equipment. It has a repeater capability to link the ICP with Base and other Camps.

3. Logistical Net - This net's principal element was to provide communication to the outside world, usually the unit dispatcher, when telephone service is not available. The system was designed for voice communication only.

4. Local Nets - National Forest local systems use an array of assigned frequencies that are duplicated across the Nation. The orginial design of the forest systems has been augmented by periodic analysis and upgrading to incorporate new technology.

5. Air Nets - This system was designed with four elements:

a. Air-to-Air communication, with four to six channels to provide separation for retardant operations on adjoining incidents.

b. Simultaneous monitoring of Ground-to-Air and Air-to-Air frequencies, but no more than two at one time.

c. Air-to-Ground communication, for directing air attack and for safety of ground personnel who may face a critical situation and need air support.

d. Long-range Air-to-Ground, for dispatch and contact with the Air Attack Base upon return.

The Cache was composed to provide sufficient units, packaged and prepositioned, to serve 15 multi-division fires at one time. To the extent possible, the same brands and models of radios were used in the caches to simplify maintenance and management of the system.

F. RATIONALE OF APPROACH

The Study Group examined the priorities involved and determined the weakest link was the Logistics Net, due to the increasing need for data transmission between the incident and the outside world. Dependency upon telephone systems must be avoided, and the transmission rates for data over a Logistics Net designed for voice transmission were too slow to be practical. The Logistics Net must be upgraded to accommodate rapid data transmission, and this was the Group's first priority. The approach taken began with needs assessments through questionnaires provided to users, fire managers, and communications personnel. The next step involved evaluation of available prototype alternatives, in bench test situations and actual fires. The Logistics Net and Service Net, dicussed in E 2 and E 3 of this Section, can be combined into one system, which is discussed in Part III A as the ICS Logistics System.

The next priority involved the management issues, associated with large fire communications. These included frequency management, training, communications management on incidents, procurement and replacement of hardware. These are addressed in Part IV.

The standards of performance and procurement involved in the National Caches and other radios used to support large incidents were examined. The approach utilized was to conduct a needs assessment through an ad hoc group consisting of Incident Commanders, Communications Unit Leaders, Cache Managers, and the Study Group. This phase is documented in Part III, A and C.

The final phase involved examination and validation of the remaining systems, including the Air Net, Travel Net, and satellites. This phase is documented in Part III, A, C and D.

The Study Group evolved their rationale for an approach to the issues by initially separating the issues into two catagories. Systems related issues are discussed in Part III, and management related issues are explored in Part IV. Recommendations and conclusions are summarized in Part II, with specific references.

PART II

ACTION PLAN
CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS AND RECOMMENDATIONS

Following are the major conclusions and recommendations of the report. Recommendations accepted for implementation indicate the responsible official and organization, with expected dates of completion. The recommendations are supported with documentation and discussion in Parts III and IV, with references provided. The recommendations are categorized into logical groupings and are not in any order of priority. Some recommendations have been implemented and a reference to the document of implementation is provided.

A. STANDARDS

1. National Incident Radio Support Cache Configuration

Reconfigure the cache systems to ICS Starter Systems consisting of a Command System and Logistics Net. (Completed FY 86)

a. The Command System will consist of:

3 Tactical Radio Kits (each with 16 VHF-FM Personal Portables)
1 VHF Automatic Mountaintop Repeater
1 VHF Remote Control Base Station
1 VHF-AM Aircraft Radio Base Station
5 VHF-AM Personal Portable Radios for helicopter operations

b. The Logistics Net consists of:

1 UHF Logistics Radio Kit (16 UHF Personal Portables)
2 UHF Remote Control Base Stations
1 UHF Automatic Mountaintop Repeater

This recommendation was implemented with the 7200/5100 letter of March 31, 1986, Cache Sizing for Large Fire and Logistics Systems (Reference: Appendix, Item VI-B). The new configuration was available for the 1986 fire season. Documentation of the rationale for this recommendation is found in Part III, A.

2. Evaluate the performance and management of the ICS Starter Systems during the 1986 season to validate the configuration, or adjust as needed.
Responsibility: Baden Due Date: August 30, 1987

3. Provide National direction for procurement, documenting Minimum Performance Specifications for VHF High Band Personal Portable Radios. Forest Communications Plans and Regional Caches will conform to these specifications. These specifications will assure compatability with the National Cache System, and will augment that system on project fires. They will improve interagency communications and support. Radio purchases must be capable of the following, in addition to meeting the agency's minimum standards and contract purchase requirements for radio procurement:
Responsibility: CS&T Due Date: September 30, 1987

a. 24 Mhz spread, any frequency combination with 2.5 Khz spacing.

b. Minimum of 13 channels to minimize field programming on large fires.

c. Field programmable externally, and capable of "cloning" from another radio.

d. Minimum of eight CTCSS tones, independently selectable, with disable capability.

e. Accessory requirements include accessory jack for Speaker/Microphone, RF Jack, keying, and low level audio.

f. Utilize batteries preferably other than sole source, and have a power output that permits the batteries to meet a Duty Cycle of 10-10-80, for two shifts of 12 hours each. This specification requires an interpolation of the existing EIA standards.

g. Rated RF output of 1 1/2-2 watts.

h. Meet a minimum of 10 years replacement cycle.

Documentation for this recommendation is found in Part III, B.

4. Pursue a joint, multi-year radio procurement contract for BLM and Forest Service, capable of expanding to include other specific electronic systems, such as RAWS, microwave, satellite use, etc.
Responsibility: Baden/Percival Due Date: December 31, 1987

Documentation for this recommendation is found in Part III, B.

5. Standardize radio types in the National Cache Systems, over the replacement cycle.
Responsibility: Baden/Percival Due Date: Continuing

Documentation for this recommendation is found in Part III, A.

B. FREQUENCY MANAGEMENT

1. Provide direction to field that only authorized frequencies will be used at an incident. Communications Unit Leaders will document and manage frequencies, under the direction of the Frequency Coordinator designated by the Region. This will include local and intra-crew frequencies that may be cleared for use in the limited geographical area for the incident.
Responsibility: CS&T Due Date: 4/30/87

2. Document the limitations and management guidelines for progamming of synthesized radios.

Responsibility: CS&T/Baden Due Date: 6/30/87

3. Define the role of a Frequency Coordinator for each Region. Primary duties involve assigning frequencies for cache deployment, advising BIFC of frequencies assigned and liaison with BIFC, and resolving frequency conflicts between incidents. This position will be preassigned, on a contiuous basis, rather than established only for the duration of an incident.

Responsibility: CS&T Due Date: 6/30/87

4. Provide direction to field on the development and management of Cooperative Agreements for frequency sharing between agencies.

(Completed)

5. Regions may consider the design and implementation of a Travel Network for communication between mobile resources enroute to incidents, and the incident.

Responsibility: Regions/CS&T Due Date: 6/30/87

6. The WO Telecommunications Staff Group, including the Interdepartmental Radio Advisory Committee and the Frequency Assignment Subcommittee members for USDA will be involved in the development of frequency management policies at Regional or higher levels. The Regional Office Telelcommunications Manager will be involved in the policy development at the Forest and Station level.

7. Develop a timetable for moving Forests presently using BIFC frequencies as Forest Nets to new frequencies.

Responsibility: CS&T/F&AM Due Date: 9/30/87

C. COMMUNICATIONS MANAGEMENT ON INCIDENTS

1. Role of the Communications Unit in the ICS Organization.

a. The communications unit performs a critical role in maintaining reliable, interference free, and safety oriented communications on incidents. In particular, insuring compliance with frequency assignments on incidents is an essential function of the communications unit. This function is growing in importance as new technological advances make misuse of frequencies easier.

b. Establish a communications unit as part of the ICS organizational structure whenever the divisional or more complex structure is instituted as a guideline. For a two division fire this unit would consist of the Communications Unit Leader (CUL) and a Dispatcher. Additional positions would be filled for larger and/or more complex incidents. Incident Commanders, implement as appropriate.

Responsibility: ICS Working Team, NWCG, Incorporate in Fireline Handbook

2. Communications Unit Position and Staffing levels.

a. Create the position of Communications Unit Specialist (CUS), to replace the position of Communications Technician, to be staffed by well trained, experienced non-technicians with practical communications skills, to assist the CUL on larger incidents. Incident Commanders, implement as appropriate.

Responsibility: ICS Working Team, NWCG, Incorporate in Fireline Handbook.

b. For the communications unit positions of CUS and electronics technician, consider establishing the following minimum staffing levels:

Size of incident: 3 to 5 divisions: 1 CUS
6 to 10 divisions: 1 CUS, 1 electronics technician
11 to 15 divisions: 2 CUS, 1 electronics technician

Responsibility: ICS Working Team, NWCG, Incorportate in Fireline Handbook.

3. Management Guidelines for Ordering And Using the National Cache to Potential.

a. Establish prompt delivery and return time limits for cache equipment and services as cache design parameters. Deliver all requested equipment and services within the specified time limits in fully functional condition. Allow a maximum departure from the established service criteria of 10 percent (i.e., must provide full service within specified time limits 90 percent of the time). Make such specifications part of the operational environment for communications personnel.

Responsibility: Baden Due Date: 6/30/87

b. Order equipment on the basis of present and projected needs. Project communications needs up to 36 hours into the future - remaining shift plus 24 hours - if the cache delivery time limits can be maintained at 12 hours or less. If deliveries to the incident are especially difficult, or cache delivery time limits exceed 12 hours by a substantial margin, extend the planning horizon as necessary.

Responsibility: IC's Working Team, Incorporate in Fireline Handbook

c. On request by incident personnel and with the concurrence of cache management, dispatch specially trained electronics technician to assist in the installation of complex or novel cache or other systems. The request may be part of the cache equipment order or may be submitted independently. The electronics technician will return to his/her duty station following the completion of the installation.

Responsibility: IC's/BIFC Due Date: Immediately

d. The Radio Frequency Authorizations (RFA's) for the National Cache are for use on Incidents only. The frequencies are cleared for use west of the Mississippi River, use of the National Cache east of the Mississippi requires coordination through the Frequency Management section of the WO. (A frequency specific list of areas to be avoided can be supplied to the FS cache coordinator prior to each fire season. This will enable the shipping of caches to Incidents in the east without prior coordination with the WO, although the WO should be advised via electronic mail of the specifics.)

4. Training Requirements.

a. Institute hands-on-training courses for Commmunications Unit Specialists and for Communications Unit Leaders in the installation and operation of communications systems on incidents. Conduct training in locations where the necessary equipment and expert guidance are available for practical communications systems work and follow up this training within six months with field experience. Assure that only personnel trained and qualified in this manner are assigned to those positions.

Responsibility: Baden/Percival Due Date: FY 88

b. Provide training to Communications Unit Leaders and to electronics technicians in aspects of communications management on incidents. This training, together with the hands-on training in the installation and operation of communications systems and field experience are required to qualify a Communications Unit Leader to fill this position on an incident.

Responsibility: Baden/Percival Due Date: FY 88

c. Before being assigned to an incident, the CUL and the CUS must have experience in appropriate positions on an incident within the three years preceding the new assignment. If such experience is lacking, a refresher course must be taken before any new assignment to an incident can take place.

Responsibility: IC's Working Team, Change Fireline Handbook

d. Train a number of electronics technicians for dispatch to incidents with complex and/or novel communications systems. Training should cover technical and managerial aspects of installing, troubleshooting, and maintaining such systems. The preferred venue for such training is the National Incident Radio Cache.

Responsibility: Regions/BIFC Due Date: FY 87

e. The primary target audience for this training is currently red-carded CULs who are not capable of deploying and managing the National Incident Radio Cache.

f. Develop Regional and Forest plans to provide radio users with introductory, practical, training and retraining in the use of radio equipment on incidents. The training should emphasise the correct use of radios and user discipline, especially with regard to frequency management. Whenever possible, this training should be made part of other required training.
Responsibility: Regions Due Date: 3/31/88

Documentation for Recommendations 1-4 is found in Part IV, B.

D. DATA TRANSMISSION SUPPORTING AN INCIDENT.

1. Continue the development, testing, and evaluation of the Packet Radio feature of the Logistics System for transmission of data between the Incident Command Post and the Forest Dispatcher.
Responsibility: Baden/Percival Due Date: Ongoing

2. Pursue the use of communication satellites as an alternative for data transmission, through an interagency effort.
Responsibility: CS&T/F&AM Due Date: FY 87/88

Documentation for Recommendations D, 1-2 is found in Part III, D.

E. RESOLVE AIR COMMUNICATIONS PROBLEMS AND ISSUES WITH ANOTHER SPECIFIC STUDY EFFORT.
Responsibility: Fuchs/Working Group Due Date: 12/31/87

Documentation of this Recommendation is found in Part III, E.

F. TELEPHONES AND RADIO TELEPHONES SUPPORTING AN INCIDENT.

1. Telephone service should be utilized at ICPs whenever it can be obtained at a reasonable cost and within allowable timeframes.

2. Repeater/Link Systems and RTI Interconnects should be provided in the National Radio Cache System for use when telephone service is not available. (Estimated 7 RTIs, with 2 remotes each, with one hop)
Responsibility: Baden/Percival Due Date: FY 87/88

PART III

EXAMINATION OF SYSTEMS

EXAMINATION OF SYSTEMS

A. SUMMARY OF INCIDENT COMMUNICATIONS REQUIREMENTS

1. In emergency situations, fire line personnel assigned communications equipment must be able to communicate directly with overhead and other ground units.

2. The Incident Commander, Operations Chief, and Branch Directors need direct communications with fire overhead, spike camps, and heliports. This "Command Channel" must provide transmission capabilities between points along the entire incident perimeter and must include provisions for communications over rough terrain.

3. Command Channel Utilization.

The Command channel must remain uncongested. The units assigned to this channel and the traffic flow must be left to the discretion of the Communications Unit Leader.

A minimum of three command channels are needed on a nationwide basis to allow the separation of simultaneous incident communications within the radius of ground radio interference. Different command channels must be clearly marked for easy identification.

4. Tactical Communications.

A minimum of three tactical channels are required to provide intra-division communication links between Operations Chief, Branch Directors/Division Supervisors, strike team leader and crew boss.

5. Simultaneous Channel Monitoring Requirements.

The Air Attack Supervisor and/or the Air Tanker Coordinator and helicopters require simultaneous monitoring of the fire line to air and the air to air communications traffic. Instrumentation for simultaneous monitoring is required. Air tankers require air to air communications when operating under the direction of an Air Tanker Coordinator or Air Attack Supervisor, but do not require simultaneous monitoring capability.

No person supporting air operations, without the support of a special radio operator, should have more than two "work channels" with simultaneous monitoring requirements. A "work channel" is one used in direct support of a specific activity.

6. ICS Logistics Support Communications.

a. Service communications from Service Center to Incident Command Post (ICP) Communications which adequately processes all logistics information created by incident (via voice or data communications).

b. Support Communications. An intra-functional communications system that provides communications within the ICP, helibase, base camp, staging areas and spike camps. The system should include operations, plans, finance, command staff and logistics and all logistic sub-functions.

7. National Incident Radio Support Cache.

A national cache must be able to supply eighteen multi-division or multiple incidents, simultaneously. Equipment is required to properly operate and control the ground communications system and to implement the air communications system in unequipped aircraft. A three shift supply of batteries should accompany each module. The arrival of cache radio equipment on the incident should coincide with the arrival of the intended users (project overhead).

8. Equipment Standardization.

Communication equipment in a national cache system needs to be standardized to facilitate use and to minimize different types of batteries and other replacement parts needed at the incident. All incident communications equipment must be clearly marked for easy identification.

9. Caches Standardization (BLM/FS).

Ideally, the personal portable radios used in the BLM and Forest Service ICS Command Systems would have sufficient channels to accomodate the Command, Tactical and Air Guard frequencies of both agencies. This would allow both agencies to provide radio support to each other by being able to come up on the same frequency or frequencies on going incidents. This would provide better support and frequency utilization in multi-incident situations.

With available technology (synthesized radios) the cost of putting both of the caches VHF-FM radio frequencies in a single radio is no longer a factor and the Cache Managers have already implemented the program at the local level as replacement radios are purchased. Frequency management and control over frequency usage is a key factor. The need for better trained Communication Unit Leaders and support personnel will become more evident with the synthesized radio.

The two cache frequency complements in the synthesized radio can be simplified with a radio having a channel select switch and a mode or code switch to select a band of frequencies such as the 48 and 64 channel synthesized radios now available. The capability to have all of the BLM and Forest Service Cache frequencies programmed into a single radio allows for fast shipment to an incident without having to preprogram frequencies. At the time of this study, requirements for Continuous Tone-Controlled Squeclch Systems (CTCSS) limit the number of channels available on the portable synthesized radios available from GE and Motorola.

As an example, the channeling layout of the synthesized radios with channel/zone or mode select switches could be as follows: (Existing radios at this time cannot do this and have CTCSS at the same time.)

Channel Switch	Forest Service Zone/Mode		BLM	
Position	"A"	"B"	"C"	"D"
1	Tactical 1		Tactical 1	
2	Tactical 2		Tactical 2	
3	Tactical 3		Tactical 3	
4	Command 1		Command 5	
5	Command 1 RPT		Command 5 RPT	
6	Command 2		Command 7	
7	Command 2 RPT		Command 7 RPT	
8	Command 3		Command 9	
9	Command 3 RPT		Command 9 RPT	
10				
11				
12	Air Guard		Air Guard	

Zone "B" and "D" could be used for miscellaneous support frequencies as needed.

The Cache personal portable radios should be of "high performance" quality that facilitates the fast turn-around requirement during fire season.

The minimum operating perimeters for personal portable radios are:

a. Synthesized and reprogrammable (without changing the PROM).

b. Sufficient channeling to accept both Caches (BLM and FS) frequencies, plus miscellaneous frequencies such as air to air and spot clearance frequencies.

c. 10 Mhz band spread in increments of 2.5 Khz.

d. 8 CTCSS tone encoder with each tone being independently selectable with encoder on/off switch.

e. DTMF encoder (required on some units).

f. Accessary jack for speaker/microphone, low level audio, RF Jack and keying.

g. Field programmable by means of a programmer or clonable.

h. Battery pack must be alkaline and meet the 10-10-80 operating life standards.

i. Size and weight must be user friendly.

10. Incident Communication Management.

The overall management of the incident communication system including assignment of channels and monitoring of the system must be under the control of a designated individual with an understanding of the communication system and of the incident communication needs.

The Incident Communications Unit Leaders must be provided with the following resources, as needed:

a. Trained incident dispatcher personnel.

b. Trained Communications Unit Specialists.

c. Electronics Technician.

d. Trained message center personnel.

In summary,the National Fire Radio Cache (NFRC) Communication Systems configured as recommended in the 1972 Telecommunications Study has served the Large Fire Organizations (LFO) well. The intent was to provide a total communications package for a Three Division Project Fire.

The usage of the cache systems has increased drastically over the past several years in support of Federal, State, and local government emergencies in addition to fires. Situations such as Mount St. Helens, the Three Mile Island incident, floods, and law enforcement have utilized cache systems.

As an example: The Federal Emergency Management Agency (FEMA) in "Federal Response to a Catastrophic Earthquake, Final Proposed National Plan" (Vol. 51, No. 125 of the Federal Register) gives the Forest Service primary responsibility for fire fighting (Annex ESF #4-Fire Fighting). In the area of communications the Forest Service is given a support role to the National Communications System (NCS) Manager (Annex ESF-2-Communications). This document states:

The Department of Agriculture (Forest Service) is to:

a. Maintain radio communications Systems for support of firefighters, law enforcement officers, an disaster recovery through the National Interagency Coordination Center.

b. Provide engineers, technical personnel, and liaison staff to assit the Emergency Communictions Staff (ECS) and to maintain the USDA radio system.

c. Provide USDA radio systems for use by damage reconnaissance teams to report information from the disaster area to the Disaster Field Office (DFA), and such other applications as determined by the radio communications coordinator. Provide a communications officer to accompany radio systems for the purpose of user training and operator maintenance indoctrination and provide additional radio systems required for the establishment of a Disaster Assistance Center Radio Net.

The NFRC systems were large in size and heavy, requiring 49 cubic feet of shipping space and weighing 1300 to 1400 pounds, which prevented shipment by single engine aircraft. This restricted readily available transportation during multiregion fire busts.

Often the systems were returned to NFRC with several of the radio kits unused. Those unused radio kits were the base camp radio kit, two out of three remote control base stations, one out of four tactical radio kits and the two accessory kits.

On larger fire situations, stacking of systems occured, with many of the support units unused.

With the coming of the National Interagency Incident Management System, (NIIMS) the study group saw the need to streamline the large fire systems to make them conform more to the NIIMS which was to start small and grow as the situation dictated.

The ICS (Starter) Command Systems and the ICS (Starter) Logistic Nets reconfigured from the old LFO Systems for the 1986 fire season have worked well, enabling NFRC to support more fires at any given time than in previous years. As an example, the cache was supporting 16 fires in Region 6 during the 1986 fire bust, plus multiple fires on R-4's Payette and Boise National Forest in addition to miscellaneous fires in other Regions. (See Appendix, Item G.)

The Starter Systems and Nets, being smaller in size, require less turn-around time than the LFO Systems did. The kits removed from the LFO systems and maintained as spare (back-up) kits gave NFRC the flexibility and capability to support additional fires and larger fires with the back-up kits without shipping a complete system or net. This prevented the stacking of unused kits on an incident.

B. LOCAL FOREST NETS

The 1972 Telecommunications Study examined the Forest Service telecommunications system in place at the time, and found it generally adequate for initial attack needs. The study documented several findings which can be summarized as follows:

1. The established local forest nets operated on an average 1.4 benefit/cost ratio. They constituted a sound investment and their existing value was validated.
2. Forest Service radios were being furnished at an average per set cost, equal to or less than a commercial telephone instrument, including FTS costs. Forest Service ownership of the system provided the required levels of service at less cost than contracting.

3. Benefits from the nets were derived through improved efficiency and effectiveness in administration, presuppression, and safety.
4. Communications and electronics planning needed to be improved.

5. Staffing, including Program Managers, needed improvement.

6. Funding deficiencies for communications and buildings had accumulated into multiyear problems and many forest systems were old and obsolete, with the average Service-wide age at 14.2 years.

7. The need for separate large multiple fire nets was apparent.

The study recommendations addressed these and other issues, and various improvements were implemented. The major thrust of the study was the design and implementation of the Large Fire Communications System of which the National Radio Cache was the principal component. The study also recommended several improvements in the local forest nets which were implemented. They

enabled the Forest Service to minimize total system costs by focusing attention on obsolescence costs and reduced preventative maintenance requirements. They strengthened program and technical direction, and contributed to a more stable financial base for replacement and construction of communications facilities. Finally, they made the communications planning process more directly responsive to user needs.

Due primarily to the depth of the 1972 study, the current local forest nets are still adequate systems. The basic configuration is sound, and radio traffic volumes are not too great to cause system failure. The Large Fire Radio Caches are utilized in large fires, freeing the local nets for initial attack traffic. Adminstrative traffic is accommodated without undue conflict.

Two significant developments create a need to examine the local nets in order to maintain their effectiveness. The first, is the development of multi-channel, synthesized radios, both mobile and hand-held personal portables, available to Federal agencies for reasonable cost. The technological improvement in this aspect of communications enables agencies to consolidate communications capablity into one radio, compared to the current system that requires multiple radios. The other related development is the dependency upon interagency communications during large fires.

The National Radio Caches enabled agencies to have common frequencies for tactical and command functions, regardless of the compatablity of their assigned radio frequencies. Communications were improved on the incident, both between agencies and between functions on the incident. Coordination of interagency resources and suppression objectives was improved when a National Radio Cache was utilized.

One drawback to the Cache was that it rendered the local agency radio useless for suppression communications. Also, if a radio user needed to maintain contact with local forces or the dispatcher, two radios were necessary. The limited number of channels in both local and Cache radios precluded dual use to any great extent.

The availablity of multichannel systhesized radios with 24 Mhz spread, that are externally programmable, offers a new dimension to integrating local nets with the Large Fire Communications System. Enough channels are available to provide for local needs, including cooperator's shared frequencies, and the designated Tactical and Command frequencies. If the Tactical and Command frequencies are not preprogrammed into the radios, they can be quickly progammed at the incident. Such radios are available on Federal contracts for reasonable prices that allow for 48 or more channels, which is sufficient to permit preprogramming of all local, interagency, Tactical and Command frequencies.

The impact of this capacity is a reduced dependency upon the National Radio Cache to provide total radio communication capablity on an incident. Primary suppression forces, including fire teams, overhead, engines, Category I crews and other agencies can arrive at the incident with radios capable of operating on the Tactical and Command frequencies assigned to the incident. They need not check out a Cache radio from the Communications Unit. They no longer need to carry two radios, to maintain contact with the local net. Mobile radios in assigned resources such as engines and vehicles assigned to overhead are usable on major incidents, and the operator need not check out a hand-held portable to maintain contact on the Tactical and Command channels. This capacity enables the Forest Service to reduce the dependency upon the Caches, and will not require the build-up of radio systems experienced in the past 10 years on major incidents.

Recommendations A-1a and A-3 are responsive to this capacity, and reconfigure the Caches to ICS Starter Systems, which will be augmented by local radios with the capacity to interface with the Cache. A number of the progammable radios will be in service in 1986, and the capacity will expand in the years to follow. The first few years will require additional Cache radios to supplement the ICS Starter Systems on incidents, but that dependency will decline, as more local radios are procured with the progammable capability. The Cache system can be periodically evaluated and may be modified in response to the actual need. The need for a Cache for large incidents will not disappear, as multiple incidents will tax the local capablity of units that may choose to maintain their own radio caches. The mission of the Forest Service is expanding to include all-risk incident support of emergencies other than wildfire, such as earthquakes, floods, and other events, both in the U.S. and abroad. Communications is one likely form of support we will be called upon to provide, and this could expand the Cache utilization.

To assure timely and coordinated procurement of local radios, National direction is needed to document Minimum Performance Specifications for multi-channel VHF High Band Radio procurement by field units. Such radios are versatile, and likely to be pressed into emergency service in support of fires and other emergency operations. Exceptions would be single channel radios without repeater or tone compatibility in support of limited functional operations such as traffic control during road maintenance. These specifications will assure compatibility with the National Cache System, and will augment that system on project fires. They will also improve interagency communication and support. These specifications will be in addition to the agency's contract purchase requirements. These Minimum Performance Specifications are documented in Recommendation A-3.

Mobile radios that meet or exceed these specifications have been commercially available for a few years, and most units are purchasing them for

vehicles such as engines and for light transporation units for fire management personnel. These specifications would not alter the current procurement patterns for mobile radios, as long as units could provide mobile radios for overhead and fire managers for fire assignments that employed National Radio Caches and utilized assigned Tactical and Command frequencies. The hand-held personal portables with programmable capablity represent a new dimension in communications on fires.

In developing the proposed specifications, consideration was given to the minimum number of frequencies to be programmed into the radios in support of large incidents and local fire needs. The basic configuration is as follows:

2 LOCAL FREQUENCIES, (FOREST NET AND REPEATER)
3 TACTICAL (NO REPEATER)
6 COMMAND (INCLUDING 3 REPEATER)
2 AIR (AIR GUARD AND AIR-TO-GROUND)
13 MIMIMUM FREQUENCIES

This is the basic configuration that would not require reprogramming at an incident employing a Forest Service cache, but it is limited in local application. It meets minimum Forest needs, but cannot accommodate adjacent forest or cooperator frequencies without reprogramming.

For radios assigned to crews or individuals who do not normally utilize the Command channels on large incidents, the 13 channels could be programmed as follows, to expand local capability:

8 LOCAL FREQUENCIES
3 TACTICAL (NO REPEATER)
2 AIR (AIR GUARD AND AIR-TO-GROUND)
13 MINIMUM FREQUENCIES

This configuration allows more local frequencies, but limits large fire communications to the Tactical Nets. This would suffice for extended attack and the first shift on incidents utilizing a cache system, but would require reprogramming at the incident to use the Command Nets, if necessary.

From the standpoint of priorities, it is much more important to have the 24 Mhz spread with any frequency combination and 2.5 Khz spacing in any radio procured, than more than 13 frequencies. The frequency spacing and spread enables units to program their own assigned frequencies, and those formally shared from cooperators who operate in the band normally utilized by wildland fire agencies in the 150.000 to 174.000 Mhz range. From the standpoint of practicality, radios are available that meet Forest Service specifications, with 48 to 64 frequencies. They seldom, if ever, need reprogamming for integration into a large incident utilizing a Cache unit. Most units would elect to procure these radios for units providing primary fire support, such as Category I crews and district fire management personnel. For other units that would be expected to provide only occasional support to fires, the 13 channel radios would suffice.

The CTCSS tone capablity is a necessary feature to minimize interference in areas of frequency congestion, and many Forest Service units and our cooperators are adopting the concept.

An integral part of this concept is the formal sharing of frequencies between agencies on a local basis. This requires suitable Cooperative Agreements between agencies to document the conditions and limitations on shared use of frequencies. Each assigned frequency has geographical limitations and other restrictions on use, and they must be understood and supported by all parties to the agreement. A sample of an acceptable Cooperative Agreement is found in the Appendix, Item D. Further dicussion of the issue of shared frequencies is found in Part IV-A of this study.

The multiple frequency capacity currently available to field units will be expanded and enhanced with implementation of this recommendation. With this increased capacity goes increased risk of frequency abuse by untrained or undisciplined users. The need for proper radio procedure becomes critical, when more frequencies are programmed into a radio than are authorized for use on any specified incident. Management of frequencies becomes a critical function of the Communications Unit, and any Region experiencing multiple large incidents. Users might be tempted to use their assigned forest frequency for intercrew communication while on a fire assignment on a distant forest when that frequency is not authorized for the geographical area. Abuses of this nature could jeopardize the Forest Service frequency assignments, and cannot be tolerated. Further dicussion of this issue is found in Part IV-A of this study.

Currently, the Forest Service and Interior agencies pursue separate contracts for telecommunications procurement. Since the agencies maintain separate but compatible National Radio Caches, and respond to differing local needs for telecommunications, this has not been a barrier to agency coordination. Both agencies have elected to go with single year contracts to enable them to take advantage of new technology each year, and not get locked into a product that fails to live up to agency expectations.

As the agencies move closer to common incident management and communications objectives, the value of a joint, multi-year procurement contract with USDI and Forest Service may outweigh the advantages cited in the preceeding paragraph. It would facilitate common upgrading and maintenance of the National Caches, and provide more commonality in field purchases. It could reduce costs to both agencies. This concept needs to be pursued in more detail by both agencies on a joint basis to assess the advantages and disadvantages of a joint contract of more than one year.

C. TRAVEL NETS

The concept of a Travel Network to provide radio communications for fire resources responding long distances or between agency jurisdictions has been explored by some agencies. The need for a National Travel Net does not appear warranted as resources with mobile radios are not often moved between regions, except in areas of mutual interest along borders. Regions may wish to explore Regional Traveal Nets.

D. SATELLITE CAPABLITY IN SUPPORT OF INCIDENTS

In accordance with FY 86 A&FM Program of Work Goals & Tasks, and their five year plan, the Advanced Electronics Group has conducted a study on transportable satellite communications systems for use at remotely located ICP's. The study was conducted under the technical direction of Dr. Peter McManamon and others of Cyberlink Corp. Dr. McManamon is a nationally recognized expert in thin-route and remote satellite communications systems, has published numerous technical papers, and has an impressive experience background. The report "Transportable Satellite Communications for Incident Command System Logistics Support" is available and has been distributed to the WO CS&T, Regions, and other agencies. The study concentrated on Ku band systems and uses a generic approach rather than concentrating on specific systems. Cyberlink is not a hardware manufacturer and the report is thus objective. The report provides the systems engineering considerations for design and operation of remote satellite communication systems. It addresses the lease of satellite transponder capacity. It also provides cost information. The study assumed an initial capability of three remote stations each having two full-duplex voice/data channels available. All six channels could operate simultaneously, via a base station located at Boise or elsewhere. This would provide automatic connection to FTS, Telco, Depnet, etc., from any ICP location.

In addition to the remote area/ICP links, a separate study, also included in the report, was conducted which discusses satellite vs microwave communications for a typical National Forest. The Olympic NF was used as an example forest with information provided from the R6 Telecommunications Staff. The intent here is to provide the technical information and comparisons necessary to evaluate any particular Forest, recognizing that all are different and have different requirements. The example should be useful to any Region's Telecommunications Staff for planning, comparison, and evaluation when considering replacing or updating a forest communications system.

Telecommunications personnel from R1, R4, R6, and BIFC also participated in the meetings held with Cyberlink and provided valuable information and contributions to the study. Cyberlink conducted a training session which provided comprehensive technical discussion of satellite communications systems, engineering considerations, channel requirements, etc., for all participants. A separate technical report, "Engineering Guidelines for Small Earth Station Antennas" was also completed.

Additional information on other systems is also included herein. This report will summarize the findings to date and provide recommendations for future action.

Transportable satellite ground stations are now available in a reasonable size/weight/complexity for use at ICP's. They are still quite expensive, compared to traditional communications, but the advantage is that they offer reliable two-way voice/data communications from almost any remote site with only 30 minutes or so needed for initial set-up. They could also tie in to the DG system, and process fire orders and other information by computer terminal rather than by voice.

A transportable satellite station generally communicates via satellite to a base or master station. The base station then interfaces to Telco lines at a PBX. The remote station thus has access similar to the telephone or data terminal sitting on a desk. The base station may be procured and installed on user premises, or in other cases may be a very large station operated by a satellite transponder owner. In that case, the user must pay for the interconnect services and pay long distance charges from the large location to the destination of the call. There are several variations on how all this could be accomplished but in most cases it would be transparent to the remote station user.

The major cost problem faced by the Forest Service and similar agencies for incident logistics communications by satellite is the small quantities of systems involved and the small portion of transponder bandwidth to be used. The estimated portion of transponder bandwidth required for the six full-duplex channels mentioned is about 1.5%. Naturally, brokers would much rather deal with a user requiring the full transponder bandwidth than with 70 or so customers using a small portion of bandwidth. There are also potential technical problems in managing a group of small users. An initial trial use involving three or four stations and perhaps building up some day to a maximum of 15 or so for fire cache use is also not too exciting to equipment suppliers compared to orders for 3000 to Farmers Insurance, 25000 to Federal Express, or even 100, initially, to Schlumberger. However, these larger quantity orders will eventually help bring the price down even for small users.

1. Costs:

Costs are extremely difficult to get a handle on when talking in generalities. The suppliers of equipment and the brokers of transponder capacity are very hesitant to give any general quotes and want everything quantified. There are also system design trade-offs which are interrelated with each other and affect costs. Without going into the technical details, transponder power, bandwidth, modulation methods, and antenna size all must be considered as well as number of voice/data channels and the length of the lease time.

Cyberlink estimates costs of $56,500 for each transportable station and $88,500 for the base station. This includes all the interconnect equipment and is based on estimated costs of the various electronic units which comprise the stations. It does not include auxiliary equipment, spares, contingency, systems engineering, etc. An informal quote from Modulation Associates was $45,000 to $50,000 for transportables and $50,000 to $75,000 for the base. Another company also indicated about $50,000 for base stations. All these systems would operate in the Ku band.

Cyberlink obtained a quote of $10,648 per month for a nine month lease of six full-duplex channels. Modulation Associates estimated $8,000 to $12,000 per month for a six month lease of five channels.

Pacific Telecom has proposed lease of either two or four channel remote stations. The lease cost is $9500 per month for two channels, or $17000 per month for four channel stations for a six month lease time. Those costs include all necessary equipment and the satellite channel costs. The PacTel system uses a 1.8 meter dish at the remote site and transmits to their hub station in McLean, VA. The user would pay the long distance toll charges from McLean to the call destination. Their system comes in six transportable containers and weighs 455 lbs. That is somewhat larger and heavier than desirable but not unusable. The system could be transported in a pickup or van. They did their engineering homework and have included link budgets and technical data to support their proposed system.

Meanwhile, Telesystems, a Comsat Co., has demonstated a transportable station using the INMARSAT satellite with a cost per remote of about $40,000. Their system uses their own ground station and the cost is $10.00 per minute of actual use. Long distance charges from either their west coast or east coast station are included in that. For example, using the $10.00 rate, if two channels were used for two hours a day, the daily charge would be $2400. In only five days the cost would exceed the monthly lease rate of six channels as priced by Cyberlink, and in four days would exceed the $9500 monthly cost of a PacTel two-channel station! On the other hand, the Telesystems channel cost is zero when it is not in actual use and with judicious use of off-line preprocessing of data could be as low as $30 per day or so for fairly large fires.

2. Demonstrations and Applications

a. Telesystems uses the INMARSAT satellite originally intended for ship-to-shore communications. We called them last summer, based on their advertising, but they couldn't provide a station at that time. Cyberlink had also looked into their capabilities earlier on another project and didn't recommend them. However, they now state that they have FCC and the Inmarsat Consortium approval for land use of the satellite and that stations are available. They demonstrated the transportables at Boise, and later at Sacramento for the CDF, and at the City Creek Ranger Station in the San Bernardino NF. Because the Inmarsat satellites are located over the middle of the oceans, there was considerable concern about the low elevation angle (less than ten degrees) of the dish antenna. At City Creek, the dish was pointed partly through a tree and toward a mountain about 3/4 mile or so away and at least somewhat in the line-of-sight and it still worked quite well for voice communications. The Inmarsat stations operate at L band and use a 35-inch diameter dish. At L band that provides an antenna beam width of about 15 degrees so antenna pointing is not nearly so critical as at Ku band. In fact, we rattled the dish around somewhat with no noticeable effect in the voice quality. Set-up time is less than 30 minutes for a trained person and use is almost as simple as a normal long distance call--even simpler than a long distance credit card call! Telesystems has not provided any lease costs for their remote stations, but often if a lease is for several months or a year one may approach the purchase price. They also have not provided a link budget (range equations) as requested, nor any information in writing about the long term status of using a maritime satellite for land communications and the future availability of channel capacity.

b. Region 1 planned to lease two transportable satellite stations for the 1986 fire season. They coordinated this with CS&T and have an OK on the Depnet bypass. Their units will operate on a Ku band satellite using spread spectrum modulation techniques. They will have only one data channel (no voice capability) at 2400 bps. Very little technical information is available about these stations at this time. The Region 1 lease cost is only $500 per station, plus $400 per month. Region 1 plans to integrate these into the DG system so that DG terminals or other computers or terminals can be used at the ICP.

c. A summary report of BLM/BIFC's usage of the L Band Satellite System is located in the Appendix, Item H. The L Band System offers a very protable communications media that can be installed quickly and easily, relieving frequency congestion and providing reliable communications. The operational costs of this system seem to preclude its use for incident management for extended periods of time. As marketplace competition and possible transponder cost reductions occur, this type of satellite communications may answer certain incident communication requirements and become viable.

d. Data communications can now replace at least some of the traditional voice communications used at incidents. In most cases data communications will be much more efficient and accurate. Most folks seem to believe a combination of voice and data is best for the foreseeable future. Many of the routine messages such as status reports, resource orders, demobilization rosters, etc., can be much more efficiently handled by data. But, where interactive discussions or various situations are needed voice should be available if possible. Satellite communications can provide both capabilities.

Data communications also needs to be evaluated in terms of off-line processing vs. on-line, networking, etc., to determine the need for portable computers -vs- remote terminals, amount of channel time (costs), channel availability, operator capabilities needed, and other considerations. Another study group is investigating ICS data communications needs.

e. Conclusions.

The above costs are significant and need to be evaluated by Fire Managers based on the need for providing reliable two-way voice/data communications from ICP's almost regardless of the location. The costs can probably be reduced somewhat through additional investigation, study, and competitive procurement. It is almost certain that the costs will come down as systems in the Ku band enter into volume production and as brokers become more willing to deal with small-time users.

It is quite difficult and risky to develop recommendations in this rapidly changing area of Very Small Aperture Terminals (VSAT). It is now 10 years since the technical feasibility of transportable small earth station satellite communications from a remote site, was demonstrated.

It is suggested an interdisciplinary team of fire, communications, ADP, should be activated by the NWCG to address the voice/data communications needs for incidents of various sizes. This would consolidate and coordinate the variety of information which is presently available and which will be forthcoming from field experience this year and should result in an implementation recommendation. The Advanced Electronics Group could take the lead in developing the technical specifications, procurement documentation, and proposal evaluation, assisted by two or three Regional Telecommunications personnel, CS&T, and BLM. This could incorporate the use of a consulting firm.

E. AIR COMMUNICATIONS

During the past two fire seasons, there has been a marked increase in the scope and complexity of air operations functions with regard to aircraft involved in fire suppression activities. Although ICS policy addresses air

operations in detail, each air attack organization operates somewhat differently because of practices and policies developed in their home regions, and when these organizations operate outside of those regions, which is often the case, these differences develop into problems. When two or more of these organizations find themselves operating in the same airspace, ordering air tankers from the same source, and combining functions, the problem areas are more readily apparent.

In many cases, the problems are not operational or tactical in nature; they are in one way or another related to communications, either with radio equipment itself, or the manner in which it is implemented. The use of National Air Net frequencies, Air Guard channels, FAA controlled "Victor" channels, and tactical radio frequencies is a source of confusion for all but the simplest of air operations. Although an isolated Class 1 or Class 2 incident can usually operate without much difficulty, the trend over the last two years has been bigger airshows, in a more concentrated area, with more congested airspace and radio nets. It is the needs of this larger, more complex organization that must be addressed.

Several limitations and problem areas contribute to the difficulty of implementing an SOP for tactical air communications:

Air/Ground TAC channels that are available for use on incidents are dependent on the radio cache in use on the incident; this is a variable, and not very flexible, but also not a problem when utilized properly.

Air/Ground TAC channels that are available for use on incidents are dependent on the radio cache in use on the incident; this is a variable, and not very flexible, but also not a problem when utilized properly.

Regional opinions on the use of National Air Nets and Air Guard frequencies are directly opposed to each other, and in most cases incorrect. (i.e., Region 1 uses Air Guard as a Tanker dispatch channel; some Region 5 Air Ops organizations use it as an initial contact and flight following channel).

The FAA cannot be counted on to correctly assign or police AM Victor channels, even though that range of frequencies is their province. The FAA perception is that the assignment of a few AM Victor frequencies to the regions will satisfy all incident aircraft requirements, and this is not the case. Even when additional Victor channels are made available, frequency management is the responsibility of the incident. (i.e., five Victor channels each were assigned to Regions 4 and 5 this season for fire use; two of each were in common with the neighboring Region and conflicts resulted.)

The equipment in call when needed aircraft is a factor in communications system efficiency. Many CWN ships have only 360 channel AM VHF radios, instead of 720 channels, and even an aircraft with a 9600 channel VHF is limited in its effectiveness if it has only 360 channel radios. Many more frequencies are avilable from the FAA in the 720 channel capable range than the 360 range, and they are more readily available.

9600 channel programmable radios are always a high priority and usually in short supply. Some portable models are available for aircraft that do not have prewired systems to accommodate them, but these are also limited in number.

Most of these problems, and the many others that will be identified and addressed at a later time, are not detected until a unit is deployed to an incident and then finds itself lacking, either in equipment or utilization policy. At these times, it is the Communications Unit that is usually tasked to solve the problems and establish policy, and these people are not generally any more capable of dealing with aviation communications problems than the air operations personnel themselves.

Lessons learned this season, with the multilevel, increasingly complex, and sometimes overlapping Area Command type of incident management, have identified the need for trained aviation communications coordinators to operate between incidents, area commands, and even between forests and neighboring regions to reduce congestion and conflicts, and coordinate the overall tactical aircraft communications system.

Also recognized, is the need for a group of persons from the air attack/air operations sector, and communications personnel versed in aviation communications to form a group to identify problem areas, and evaluate possible solutions for some of the shortcomings of the present system. One Standard Operating Procedure nation wide will not solve regional problems, and there is no intent to redesign the incident air operations concept in order to accommodate communications problems. However, ICS Air Operations policies have variables and flexibilities built in that are not being recognized or utilized, and cooperative discussions and proper training by qualified individuals in the system can eliminate most of the obstacles to a coordinated system before next season, if acted on in a timely manner. For these reasons, a new tactical air operations communications policy will not be included in the telecommunications study at this time, until the proper persons from the involved agencies can assemble and deal with the overall problem effectively.

Dennis Lanum, of BLM's Field Operations Group at BIFC has documented some proposals for air operations communication planning, drawing upon his participation in major incidents during the 1986 and 1985 seasons. They can provide a starting point for development of interagency operating proceedures. These proposals are found in the Appendix, Part F.

An interagency study group should be assembled to address these air communications problems, and Dennis Lamun would be a logical participant to represent BLM in such an effort. This recommendation is documented in Recommendation E.

PART IV

EXAMINATION OF MANAGEMENT

PART IV - EXAMINATION OF MANAGEMENT ISSUES.

A. FREQUENCY MANAGEMENT

1. Frequency Management in Incident Communications.

a. Frequency Management is the management of spectrum. The study group specifically investigated the requirement for the management and control of all radio frequencies in use on incidents.

Each frequency used must be specifically authorized for the geographic area of an incident. Frequencies are authorized through a Radio Frequency Authorization (RFA) issued by the National Telecommunications and Information Administration (NTIA) for the Federal users, and as licenses by the Federal Communications Commission (FCC) for the non-Federal users. The RFA or license specifies the geographic area, type of operations permitted, and specific limitations. General regulations pertaining to frequency management are found in the "Manual of Regulations & Procedures For Federal Radio Frequency Management" for federal use, and in the "FCC Rules and Regulations" for non-federal use. Few if any users at an incident are knowledgeable of the regulations under which radio equipment is used, and most have misconceptions. This study does not propose to make all users experts on the regulations, but suggests users should have a general awareness of the pertinent ones, and operations should be brought into general conformity with the applicable rules and regulations.

A common misconception of a typical Forest Service radio user is the belief that fire and all incidents are emergencies; justifying the suspension of all rules and regulations. Fire in general is not classified as an emergency by the NTIA. Most fire situations do not fit the definition which calls for a large area or community to be under immanent threat of loss of life and property.

At the present time the Federal Government has approximately 200,000 Radio Frequency Authorizations nation-wide with over five percent (approximately 10,000 in 1985) being added annually. The Forest Service has approximately 9,500 Radio Frequency Authorizations, 8000 of which are for the Land Mobile Service (LMS). The numbers in the LMS are expected to remain relatively stable over the next few years.

b. Requirements for spectrum related to incident communications.

The National Interagency Incident Management System (NIIMS) and the Incident Command System (ICS) have demonstrated the desirability and advantages of using available radio equipment for inter-communications between the units of disparate agencies, Federal and non-Federal. The advantages are especially apparent prior to deployment of the BIFC caches. The temptation arises to use all the frequencies installed in the radios available. Forest Service units often inappropriately use their home forest frequencies as private networks, for intra-crew or for communications with other units from their home forest.

Non-Federal units on occasion have been erroneously encouraged to do the same with the non-Federal frequencies. Such use when outside the geographical limits of the original RFA/license, disrupts the communication networks of agencies that do have RFA/license for the area. These "bootleg" operations are not permitted. Many users rationalize such operations on the erroneous belief that Forest Service frequencies are "owned" frequencies and therefore available to Forest Service units everywhere. Complaints of such unauthorized use are increasing each year.

Regulations for unauthorized use demand immediate cessation of operations. It should be pointed out that certain frequencies, in certain areas, can not be used under any circumstances. Some of the authorizations are to operations other than Forest Service and may be classified on the basis of national security.

c. Frequency Management and The New Technologies.

New technologies since the 1972 Communication study have made possible capabilities in communications equipment considered unfeasible in 1972. Greater bandspread (the ability to cover a larger portion of the spectrum), the introduction of synthesized radios (eliminating the need for crystals), and the introduction of re-programmable radios are three examples of the new technologies. This has a substantial affect on frequency management. Synthesized radios with the capability of easy programming for large number of frequencies (some can be re-programmed by the user), have introduced a potential for even greater misuse than the radios previously used. Reports of interference indicate that this concern is justified.

2. Examination of Frequency Management Issues.

a. Requirements of Units In Transit To An Incident.

Several Fire Management Officers and associated Regional Telecommunication Managers have suggested the desirability of nation-wide frequencies available to any Forest Service (FS) unit away from it's home Forest. The stated need for such frequencies vary with the requester, the most often cited is for intra-unit (e.g. within strike teams) communication, and for contacting units in transit. Three Regions are currently investigating the possibility of similar nets on the same frequency (169.125 MHz) used by the California Travel Net, although not necessarily using a repeater.

It has been suggested to use nationally available "common user" channels, 163.100 and 168.350 MHz, for intra-crew use. The frequencies are designated "common user" (168.350) and "wide-area" (163.100) channels for all Federal agencies. These frequencies are authorized on a no protection non-priority basis, i.e. the first one to start using the channel has possession of the frequency until their communication is completed. The use of CTCSS tones on these channels is strongly recommended in the NTIA Manual. The intent of these channels is for intermittent use where a regular frequency

assignment is not justified. The frequency is not intended for life threatening operations, or operations of a critical nature. The use of the frequencies is not part of the Recommendations for National Policy in this study. Its use may have application at the Regional level. All Regions currently have Region-wide authority on these frequencies.

The Bureau of Land Management (BLM) has made a suggestion in which they would provide a new frequency for air guard (167.950 MHz) and a frequency for initial contact (168.550 MHz) if the FS would make the current Air Guard frequency (168.625 MHz) available as a tactical frequency for BLM and FS use. 167.950 MHz is a clear frequency along the Mexican border and it may be possible to coordinate with Mexico to keep it clear. 168.625 MHz is receiving interference from several stations in Mexico. The frequencies will remain under the control and management of the respective agencies (FS & BLM). Agreements on the specific use are for purposes of mutual benifit. Any other agency, Federal or non-Federal, would be required to be signators to cooperative agreements with either of the two agencies before being allowed to use the frequencies. This proposal has merit and should be addressed in the resolution of the air issues as proposed in Recommendation E.

b. Responsibility For Frequency Management At The Incident.

The requirement for Frequency Management is frequently neglected until after problems develop on the incident. Whenever Federal frequencies are utilized, the frequency management requirement for responsibility to a single function or person exits. It may be the Forest Dispatcher for small incidents on a Forest, the CUL, or someone else may have the responsibility. The Federal Agency providing the frequencies is responsible for the management and control of the use of those frequencies. When a Cache is dispatched to an incident in which the recipients do not have expertise in the management of the cache, operational and managerial problems may arise. The agreement between the Forest Service and the Federal Emergency Management Agency (FEMA), as outlined in the "Federal Response to A Catastrophic Earthquake, Final Proposed National Plan", provides for a "Communications Officer" to accompany the cache for the purpose of user training and indoctrination. To be consistant with ICS, this would be a Communications Unit Leader. This procedure should have applications for all deployments of the Cache.

1) The Communications Unit Leader (CUL) at the present time is instructed to make a list all frequencies used in support of an incident on the Communications Plan (Form ICS 205). Observations from incidents in the 1985 fire season, indicate that the principal frequencies listed in the Communications Plan are for the BIFC cache. Other frequencies in use, including the Air (air tactics, aircraft VHF, etc.), are frequently overlooked. It has also been observed that the CUL may not know that "private" networks, authorizied and non-authorized (to the area), are being used. The CUL should make personnel on the incident aware that frequencies not covered in the ICS 205 Communications Plan are not to be used.

A large number of CULs learned the position primarily through on-the-job-training. They may not be cognizant of the problems of Frequency Management on incidents. Primary concern and emphasis, has always been on effective utilization of the BIFC caches. That emphasis on the problem of a few frequencies, and always the same ones, may leave them un-prepared when faced with an incident in which the BIFC frequencies play a minor role.

The CUL is frequently hampered by:

Not having a knowledge of available resources other than BIFC.

The inability to obtain timely information on frequencies being used in the area that may affect operations on the incident.

The lack of a central point for assistance in frequency management concerns.

2) The position of Frequency Coordinator has been tried at the Regional and Zone levels. In satisfying the National commitment to NIIMS and a requirement for prudent frequency management on incidents, the position can assist and advise the CULs on Incidents, act as a coordinator/liaison with BIFC, and at the same time plan for optimum use of available frequency resources during conditions of multiple large scale incidents. The position should be of great benefit to BIFC as a single contact point for determining the use of the Cache frequencies in an area.

The position of a Regional Frequency Coordinator requires knowledge and management abilities greater than for a CUL. Coordinators should:

(a) Have knowledge of available resources, e.g. caches other than BIFC.

(b) Have knowledge of, and know limitations of, frequencies in use and/or available in the area. Coordinate the use of frequencies on various incidents, including the assignment of Cache and other available frequencies. May initiate requests for spot approval of frequencies.

(c) Coordinate the use of Frequencies on multiple incidents. Keep BIFC appraised of the locations of the caches, and the BIFC frequencies in use. Know what is going on in adjacent Regions/areas and minimize the potential for interference.

(d) Have knowledge of the areas of concern, e.g. general terrain, geography and topography.

c. Frequency Management Requirements at BIFC.

BIFC and Area Frequency Coordinators must know where the cache frequencies are being used. This responsibility can not be delegated. BIFC Telecommunications Management reports great difficulty in keeping track of locations where the frequencies authorized to BIFC are in use. Regionally maintained ABC Caches the utilize BIFC frequencies may create frequency management problems such as incompatability of integrating equipment. The establishment of Frequency Coordinators is expected to be of major assistance to BIFC.

National Policy for frequency management of frequencies authorized to BIFC has been compromised by:

The apparently large number of "handshake" agreements by various and sundry personnel not always authorized to do so.

A general lack of information on the policies by the field. One example is the report that some western Forests may be operating base stations on the BIFC tactical frequency 168.200 MHz. The stations are not authorized by either policy or a Radio Frequency Authorization from NTIA.

A mis-understanding by A&FM (WO, Regions, and Forests) on their role in frequency management. Frequency Management has a chain of delegated responsibility and authority starting with the Department of Agriculture's Interdepartment Radio Advisory Committee (IRAC) Representatives. A general lack of the relization that such a chain exists can result in decisions and agreements made without understanding the implications.

The result has been the use of the BIFC frequencies on Forest Nets, caches, and Regional Nets. Some of these uses are not in conformance with an organized Frequency Management Plan limiting use of the BIFC cache within the National Forest System. The inclusion of the caches in the FEMA "Federal Response to a Catastrophic Earthquake, Final Proposed National Plan" specifies a requirement for Cache use outside the normal wildfire environment, and that use is not limited to west of the Mississippi. Although use of BIFC resources under the plan may qualify as an emergency, allowing the preemtion of other users, experience has illustrated the difficulties inherent in attempting to pre-empt frequencies. It should be pointed out that Agencies other than the Forest Service also have Authorizations on these frequencies, and the development of any policy has application only to the National Forest System.

This Study is also aware of the existance of a study on the possibility/feasibility of merging the operation of the National Caches. Should such a merger be concluded, the managing agency's Department (Interior or Agrigulture) would then provide the frequencies and Radio Frequency Authorizations. Frequency management will be under the policies of that Department. This study and its recommendations relative to frequency management of the National Incident Radio Support Cache, assumes continuing Forest Service management.

d. Frequency Management of Synthesized Radios.

The study found personnel at BIFC, Regions, the FCC and the WO expressing concern over the plethora of easily programmed synthesized radio equipment. The potential for misuse can not be over-stressed. Non-synthesized (crystal elements for frequency selection) have, by their limitation to a few frequencies, effectively limited the harmful interference any given radio could inflict to a relatively small number of frequencies, usually not more than eight. Synthesized radio equipment now available, with the ability to be programmed by any user on more than 9600 separate frequencies, requires a review of management control preventing misuse by all concerned. Programing, including cloning (downloading a program from one radio to another), must be limited to a few responsible individuals. The Forest Electronic Technicians are not always available, some Forests do not have one, therefore the authorization in most situations will have to include additional personel of responsibility. This study does not intend to identify the few select individuals, other than state the requirement for the Communications Unit at an incident to reprogram and clone radios in support of the Incident.

e. Management of Co-operative Use Agreements.

NIIMS, ICS, and other cooperative structures usually consider cooperative communications as a requisite for operations. Agreements for the use of frequencies for communications of common mutual benefit are usually formulated before the need arises. A sampling of existing written agreements indicates field units are not always aware of what the document of agreement may imply by omission, or who has authority to enter into the agreements. The requirement exists for the Government's interest to protected in all such agreements.

Authority permitting the Forest Service to enter into agreements for intercommunication and coordination purposes, and to use non-Federal frequencies is detailed in chapter 7.12 of the NTIA Manual and under part 90.421.b, c, e of the FCC Rules. Cooperative agreements entered into by field units should receive concurrance from the Regional Telecommunications Managers. Regional Telecommunication Managers have indicated difficulty in managing cooperative agreements in the absence of National Policy or consensus and request assistance in this area. The WO Telecommunication Group in CS&T is charged with the responsibility to assist Regions in developing policy for cooperative agreements and should be consulted. Appendix D is a sample Cooperative Agreement that protects the interests of the Cooperators, and defines some management principals. Note the agreement is only for mobile and portable radios, base stations require coordination through the Regional and Washington Office for determination whether a license from the FCC, or a Radio Frequency Authorization from the NTIA, is required.

f. Frequency Management Policy Development.

WO Frequency Management has a requirement that it must be included in the development of Frequency Management Policy at the Regional level, and within the Staffs at the WO. A corollary is the requirement by the Regional Office Telecommunication Manager for inclusion in policy development at the Forest, Station, Area, and Region levels. The WO has indicated it does not wish to be involved with all local policy development, nor does it have the staffing to do so, but by monitoring Regional policy the WO will be cognizant of the policy trends at the local levels.

g. Frequency Management Training for Users.

Reports to this Study indicate the majority of users receive little, or at best insufficient, training in the use of radio equipment. Fewer receive any retraining. User training varies from Forest to Forest, in some instances from district to district, and from operations group to operations group. Where training is given, it frequently is little more than functional in nature; where the switches are, the Forest system for identification of radio units, a little property management, and how to initiate a call. The need exists to cover the rudimentary "rules of the game". The users may be aware of responsibilities to the property officer, but not their responsibility as an operator of radio equipment. If the statement "management begins with the user" is valid for frequency management, then the need for adequate user training is equally valid.

B. COMMUNICATIONS MANAGEMENT ON INCIDENTS

Due to improvements in communications technology and radio equipment acquisition during the last decade, communications management assumes a critical role in reliable, interference free, safety oriented communications on an incident. Synthesized radios, data transmission, specialized communication links and large amounts of equipment on incidents, all contribute to the complexity of communications management.

Much of the communications management activity must precede actual involvement on an incident and thus is outside the scope of this discussion. In particular, strike team and air attack communication channels for small and medium size incidents must be pre-planned; intensive communications management on incidents thus concerns large and/or complex incidents which require on the spot system coordination, modification, expansion and adjustment. We shall limit ourselves here to the latter communication management aspects.

1. Role of the Communications Unit in the ICS Organization.

According to the Incident Command System Manual (ICS 120, Oklahoma State Univ., October 1983, page 38), "the Communications Unit in the ICS has a major responsibility for effective communications planning, due to the potential multi-agency use of the ICS. This is especially important in determining

required radio nets, establishing inter-agency frequency assignments, and ensuring that maximum use is made of all assigned communications capability." According to the same source, the communications unit is further responsible for the installation and testing of all communications equipment, supervision and operation of the incident communications center, distribution and recovery of equipment assigned to incident personnel, and the maintenance and on-site repair of communications equipment.

The specific tasks performed by the communications unit on large incidents can be defined as follows:

Assessing existing and projected communication needs on incident (Planning).
Ordering needed communications equipment and personnel.
Distributing radio equipment and effecting radio transfers between shifts.
Assigning allocated channels and frequencies among user groups.
Participating in channel and frequency coordination among cooperators and others.
Establishing and maintaining communications networks.
Performing incidental repairs essential to the operation of the communications system, as capabilities and priorities allow.
Establishing and maintaining accountability procedures.
Insuring compliance with frequency assignments on the incident.
Requesting temporary frequencies to be used on the incident when necessary.
Monitoring networks for overload, malfunction and user discipline.
Returning equipment and releasing comm. personnel when no longer needed.
Supervising communications unit including dispatch and message center.

The ICS 120 Manual shows a communications unit as part of the ICS organizational structure for multi-branch incidents. While the need for a communications unit on a multi-branch incident is the most apparent, a communications unit may also be needed on less complex incidents such as multi-division incidents. The final decision belongs to the Incident Commander and must be based on the specific situation. The need for a communications unit should be examined whenever one or more of the following conditions are present:

Need to coordinate the use of allotted frequencies/channels on incident.
Need for specialized networks such as a data transmission network.
Possibility of interference between groups of users.
Arrival of synthesized radios which need to be programmed.
Need for technical communications skills.

If any of the above situations prevails, a communications unit may significantly improve communications on the incident. Based on the above considerations, it is the recommendation of this study to establish a communications unit whenever the divisional ICS organization is instituted.

On small incidents, and before a communications unit becomes a part of the incident organization, the task of communications management is the responsibility of the Incident Commander. According to the modular ICS concept outlined in the ICS 120 Manual, pages 7, 8, the responsibility for the communications function remains with the Incident Commander until the establishment of a logistics section. Following the establishment of the logistics section, the responsibility for the communications function is delegated to the Logistics Section Chief and remains there until a communications unit is established, at which time the responsibility is delegated to the Communications Unit Leader. Because of the varied and unrelated responsibilities delegated to the Logistics Section Chief, basic expertise may be in areas other than communications. For this reason it is generally advantageous to establish the communications unit during the early phase of logistics section implementation.

2. Communications Unit - Positions and Responsibilities.

Communications Unit Leader. The Communications Unit Leader (CUL) is the communications manager on the incident. The CUL is responsible for the implementation and adequate functioning of the radio, telephone and other communications systems on the incident.

The CUL must insure compliance with established frequency assignments and, if necessary, ask for temporary frequency assignments. On multi-agency incidents the CUL must coordinate frequency use among agencies. Under complex circumstances, they must seek the advice of the Regional Frequency Coordinator, as described elsewhere in this report.

The CUL supervises all activities and personnel of the Communications Unit. In particular, the CUL must insure the establishment and proper functioning of an Incident Communications Center and Message Center and the establishment of communications equipment distribution and maintenance locations.

The CUL is responsible for telecommunications equipment temporarily issued to the Communications Unit on the incident. In the case of multi- jurisdictional incidents, where the agencies do not share telecommunications resurces, the CUL may delegate responsibility for the cooperating agencie's resources to a Deputy Communications Unit Leader stationed with that agencie's Logistics Unit.

Deputy Communications Unit Leader. On multi- jurisdictional incidents, and other incidents with a complex ICS organization, it may be necessary to establish the position of Deputy Communications Unit Leader for the principal cooperators. The Deputy CUL provides a link for coordinating communications among separate jurisdictions. In addition, whenever a single CUL is designated for the incident as a whole, a Deputy should be named to provide relief rotation for the CUL.

Electronics Technician. The electronics technician (ET) installs complex or novel communications systems for voice and/or data transmission and establishes the required interfaces between systems. The ET maintains, adjusts and repairs equipment essential to the operation of the communications networks on the incident. The ET advises the CUL on the proper utilization of communication resources. If required to do so, performs the duties of the CUL.

Communications Unit Specialist/Communications Technician. The Communications Unit Specialist (CUS), formerly designated the Communications Technician - assists the CUL with the distribution, installation, operation and return of radio telecommmunications equipment assigned temporarily to the incident. The CUS installs standard voice and data communications systems, programs and/or clones synthesized radios, assists in record keeping and in the maintenance of communications discipline. The CUS is generally not qualified to perform communications equipment repairs, installation of complex or novel systems or troubleshoot malfunctioning systems (National Fire Radio Cache Operational Guide, 1986, page 11).

Incident Dispatcher. The Incident Dispatcher transmits and receives messages by voice and/or via computer terminal. This position provides the main communications link between the incident and outside administrative and supply centers and may also transmit messages within the incident. The Head Dispatcher advises the CUL about dispatch center staffing needs and supervises the dispatch and message center operations.

Message Center Operator. The Message Center Operator receives, records, and routes incoming and outgoing messages passing through the message center. This position organizes the flow of messages through the center and the use of the message center facilities.
Message Center Messengers. Messengers are responsible for distributing hard copy material from the message center to incident personnel.

3. Staffing Levels for the Communications Unit.

Communications unit staffing levels will generally depend on the size and complexity of the incident, the size and proximity of adjacent incidents, new incidents and/or danger of new incidents elsewhere, the type of communications equipment needed, available outside support for specialized communications needs, and the size of the workforce pool which can be tapped for communications unit personnel.

The ICS Field Operations Guide (ICS 420, Sec. 2-4) shows the following positions and minimum staffing levels per 12 hour period for communications units serving various size incidents:

UNIT POSITION	Number of Divisions: 2	5	10	15	25
	STAFFING LEVELS				
Communications Unit Leader	1	1	1	1	1
Head Dispatcher	1	1	1	1	1
Incident Dispatcher	1	2	3	3	4
Message Center Operator		1	1	2	2
Messenger		1	2	2	2
Communications Technician		1	2	4	4

The present study provides no recommendations concerning the staffing levels for dispatchers, operators and messengers and the levels shown above will remain unchanged in this report. However, the position of Communications Technician is modified to reflect the involvement, jointly or separately, of the Communications Unit Specialist and of the Electronics Technician. For incidents up to five divisions, and again for incidents of size 10 divisions and larger, modified staffing levels are proposed as shown in the revised table:

UNIT POSITION	Number of Divisions: 2	3	5	10	15
	STAFFING LEVELS				
Communications Unit Leader	1	1	1	1	1
Head Dispatcher	1	1	1	1	1
Incident Dispatcher	1	1	2	3	3
Message Center Operator			1	1	2
Messenger			1	2	2
CUS/Electronics Tech.		1	1	2	3

The indicated minimum staffing levels per shift, for the CUS/Electronic Tech. need not be filled on a full-time basis for each level. Some technical assistance may be provided with the dispatch of National Incident Radio Support Cache equipment. This assistance is provided for the sole purpose of establishing the communications system(s) provided by the cache. Following completion, the Electronics Technician is expected to return to the duty station. The dispatch of a technician to accomplish certain tasks and return may provide a more efficient mode of utilizing a scarce resource than would be the case with a fixed placement. However, as the incident grows in size and complexity, the specific tasks requiring the skills of an Electronics Technician may expand to require full time attendance, thus justifying the inclusion of this position in the staffing table.

It is the recommendation of this study to increase the utilization of well trained Communications Unit Specialists on large incidents. The CUS would assist the Communications Unit Leader (CUL) in all tasks pertaining to the communications unit with the exception of the most technical tasks such as trouble shooting and field repairs. This, in turn, would lighten the workload of the Electronics Technician and make the Electronics Technician available to serve on other incidents, if necessary.

4. Management Guidelines for Ordering and Using National Caches to Potential.

The concepts outlined here are based on the assumption of a maximum cache delivery time of 12 hours from time of request. It is further assumed that the cache will deliver all requested systems and services to the incident, with only minor exceptions:

Ordering Equipment and Personnel. Good communications are essential to the conduct of emergency/fire suppression activities. It is therefore essential to order needed equipment (and personnel) at the earliest possible time for smooth communications during the crucial build-up stage of the incident operations. For this reason we suggested earlier in this report that a communications unit be established whenever the divisional ICS organization is instituted.

It is necessary to guard against a tendency to request more equipment and/or personnel than needed. The recommendation of this study is to base equipment and personnel requests on the basis of projected needs during the 36 hours following order initiation (remaining shift plus 24 hours). Additional requests should be placed as the needs become identified. It is the intent of this and other study recommendations to assure cache deliveries within the established time limits so that a reliable supply chain can be maintained.

Requesting Correct Configuration for Incident. With the introduction of smaller cache units (ICS Starter Systems), there is a responsibility devolving on the CUL to assure the ordering of all system components required on the incident besides the correct number of starter systems. Additionally, care should be exercised to limit the order to present and near future needs (up to 36 hours from time of request). Additional equipment should be ordered when the need is identified. Technical assistance is available from the Cache for systems design and technical components.

Dispatch of Electronics Technician with Complex Cache Equipment. It is a recommendation of this study that the National Incident Radio Support Cache train a number of electronics technicians to install complex communications systems on incidents. This service should be provided on request from the incident command (CUL or Logistics Section Chief) and with the concurence of the Cache management. Such assistance would be limited to the installation of the system in question. The technician would be released following installation to return to the duty station. This service should generally not be requested if a well trained Electronics Technician is already present on the incident.

Distributing radio equipment and effecting radio transfers between shifts. The CUL must establish a place in the camp area for the distribution and minor maintenance of radio communications equipment - the communications distribution center. This is also the natural location to which to return equipment either after shift completion or during demobilization. The most desirable place to transfer radios from one shift to another is the fire line because this minimizes the number of radios required. This is, however, in some cases

impractical and the distribution center is a possible alternative. Additional equipment is needed if a complete transfer of radios from one shift to the next is not feasible.

Establishing and maintaining Accountability Procedures. All communications equipment not permanently assigned to a user must be identified for eventual return to the Cache or point of origin. Procedures to keep track of the whereabouts of such equipment must be instituted and maintained for the duration of the incident.

Conserving Cache Resources. Prompt return of all unused cache equipment is essential. This is part of the cache design concept and is essential for prompt service to incidents. The same applies to technical assistance. Technicians assisting with installation must be released promptly for reassignment.

Cache channels and Frequencies. The frequencies on which cache equipment operates have been preassigned and generally there exists no need for modifications. The proper channel selection and assignment is, however, still the responsibility of the Communications Unit Leader.

Monitoring Networks for Overload and User Discipline. The CUL is reponsible for maintaining adequate communications facilities on the incident. The CUL can keep abreast of conditions by periodic tuning in on network communications, by periodic test transmissions, by informal interviews with users or by electronic and electromechanical devices. The latter will generally reveal only overload conditions; separate monitoring for network discipline would also be necessary. The required timing of monitoring depends on network conditions and is less if no problem conditions exist.

5. Training Requirements.

The adequate training of CU personnel and of communications equipment users is essential to good communications. This training should emphasise the practical aspects of communications management and should be repeated at intervals, especially after prolonged periods of disuse. Recent field experience or training should be required to maintain full accreditation. Required training, experience and physical fitness requirements are documented in the Wildland Fire Qualification Guide, Document 310-1.

Communications Unit Specialist Training Requirements. The training of the Communications Unit Specialist represents the basic level of training for this position and for the position of Communications Unit Leader. The training should be hands-on and should be followed by field experience within a short time (six months or less) after completion of training. The training should include the practical aspects of the following:

Network installation, including repeater positioning and channel assignment.
Network separation for interference free operations.
Programming and cloning of synthesized radios.
Power source installation and maintenance.
Basic telephone connections.
Accountability procedures and record keeping.
Essentials of communications planning.

This level of training will require a minimum of 24 hours of demonstrations, lectures and hands-on experience. The qualifications prerequisites and specific training packages must be developed.

Communications Unit Leader Taining Requirements. The training of the Communications Unit Leader should consist of the training for the CUS outlined above and elements of Communications Management such as:

Communications requirements of various organizational units on incidents.
Types of incident communications networks in use, their function and design specifications.
How to identify and prevent communications breakdowns such as channel overload and frequency interference.
Proper use of communications resources including frequency management.
Procedures for requesting temporary frequency assignments.
Procedures for coordinating communications with cooperators.
Possible areas of inter-agency and cooperator conflict.
Accountability procedures.
Procedures for requesting personnel and equipment.
Demobilization procedures.
Categories of pre-established agreements and procedures for incident communications with cooperators.

Training for Electronics Technicians. The National Incident Radio Support Cache should train a number of electronics technicians for dispatch with complex or novel cache systems. The function of the individuals thus trained would be to install cache systems (or other specified systems) on the incident and return to duty station.

Communications management training of the type suggested for the CUL may be of benefit to Electronics Technicians in their work on incidents. For this reason we recommend that communications management training be made available to electronics technicians whether or not they function regularly in the capacity of communications unit leaders.

The technical aspects of electronics technician training need not be considered here.

Incident Head Dispatcher Training Requirements. The training and experience requirements for Incident Head Dispatchers are documented in the Wildland Fire Qualification Guide, Document 310-1. This key position is more than a radio operator, and requires prior satisfactory performance as a Dispatcher on an incident, or as a trainee. No training course has yet been developed for this position, and that needs to be done.

User Training. Continuing user training is essential to good communications management. This training should be practical, user oriented and presented in a minimum of time. The training should emphasise the correct use of radios and user discipline, especially with regard to frequency management. Whenever possible, such training should be combined with other required training. A two to four hour block of time should be sufficient for the basic introduction to the subject or for a refresher course.

Some of the material necessary for the development of a Communications Management training course can be derived from the 1972 Forest Service Telecommunications study. Other material must be developed from new sources.

PART V

REFERENCES

A. A Study of Forest Service Telecommunications, Volume IV, Dated 1972.

B. Wildland Fire Qualification Guide, Publication No. 310-1 of the National Wildfire Coordinating Group, 1984.

C. NWCG Fireline Handbook, Publication No. 410-1 of the National Wildfire Coordinating Group, March 1984.

D. Incident Command System, published by Fire Protection Publications of Oklahoma State University, October 1983.

PART VI

APPENDIX

A. Update of 1972 Telecommunications Study; 7220 Document of May 14, 1984 (Forest Service).

B. 7200/5100 Letter of March 31, 1986, Subject: Cache Sizing for Large Fire and Logistics Systems (Forest Service).

C. Sample Cooperative Agreement to share radio frequencies between agencies.

D. 7200 Letter of June 18, 1986, Subject: Progammable Radios as an example of direction.

E. National Aircraft Radio Frequency Direction Work Group Effort from BIFC, April 14 and 15, 1982.

F. Informal air communications issues and proposals from a 1986 assessment by Dennis M. Lamun, Field Operations Group, BIFC.

G. 1986 Summary of ICS Starter System deployment on major incidents.

H. Summary of BLM/BIFC use and deployment of satellites during the 1986 season.

I. Schematic chart depicting the various radio nets utilized on a typical incident, and the relationship of the Incident Communications Study to related efforts to coordinate data transmission from the incident to the agency dispatcher and BIFC.

UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

7220 (A&FM)

UPDATE OF 1972 TELECOMMUNICATIONS STUDY

Missoula, Montana

May 14, 1984

U. S. GOVERNMENT PRINTING OFFICE : 1980 O - 309-842

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Appendix Item A

7220 Communications Planning
(A&FM)

Missoula, MT
May 14, 1984

UPDATE OF 1972 TELECOMMUNICATIONS STUDY

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7220 Communications Planning
(A&FM)

Missoula, MT
May 14, 1984

UPDATE OF 1972 TELECOMMUNICATIONS STUDY

Introduction

By 7220 letters dated March 12 and April 16, 1984, WO Aviation and Fire Management chartered an interagency task group to:

Verify the need to update the November 1972 National Telecommunications Study as it relates to fire suppression activities.

Develop a charter and study plan to guide a subsequent group or organization in updating the 1972 study in F.Y. 1984/1985.

The interagency task group consisted of:

E.G. Heilman - Group Leader (retiree, FS volunteer)
John Warren - FS WO A&FM Advanced Electronics Group
Les Helms - FS BIFC Communications
Bruce Jacobson - FS WO CS&T Beltsville, MD
Duane Herman (representing Dick Astley) - BLM BIFC Information Systems Mgmt.
Jack Peters (representing National Assn. of State Foresters) - Montana Dept. of State Lands, Missoula, MT

The group met May 7-10, 1984, at Boise Interagency Fire Center. During this period Gordon Stevens, retired Boise National Forest Fire Management Officer; Dick Astley and Ken Renninger, BLM BIFC, provided valuable information and assistance.

After considerable discussion, centered principally around new telecommunications technology which has become available since the 1972 Study was published and implemented, the group agreed that a review and update of the 1972 Study is not only justified but highly desirable, preferably in the very near future. At the same time the group felt that many of the basic concepts in the 1972 Study are still valid and should not be discarded or reinvented. For example, the 14 large fire communciations system requirements listed on p. 10-12 of Vol. IV of the 1972 Study need only be updated with new Incident Command System organizational terminology but is otherwise entirely valid. A major area to be considered as a part of an update is that of data communications, in recognition of the fire applications of the FLIPS concept.

The group felt that current review and updating of the 1972 Study is in reality a form of response to the Supporting Technology subsystem of the National Interagency Incident Management System (NIIMS), already approved by WO letter 3130/5130 5/26/82 for implementation within the Forest Service. NIIMS implementation provides not only the opportunity or framework but also the requirement that FS fire telecommunications be designed and operated with cooperators in mind.

The group also felt that any updates or proposed actions must be realistic in view of the constrained budgets that are likely for the foreseeable future. Any proposed recommendations must be subjected to a formal, intensive value analysis before presentation to the Chief for approval.

Goal for Updating

Provide a telecommunications (ref. FSM 6905) networking [1/] strategy that interfaces with cooperating fire agencies to include voice, data, and video transmitting and receiving capability.

Objectives/Constraints for Update Study

1. Scope of the update: results of the update apply to the Forest Serivce only, but the updating will be done in close consultation with USDI and the National Association of State Foresters.

2. Depth of the update: Most of the principles in the 1972 Study are still valid and need not be reinvented. The principal thrust of an update should be to apply new technology to the still-valid principles of the 1972 Study. More specifically:

o synthesized frequency radios offer greatly expanded flexibility for both Forest net and radio caches, permitting (among other capabilities) much fuller interaction within the FS and also with cooperators. This concept is discussed in the February 1983 Productivity Improvement Team report, "Overhead Support".

o FLIPS is an integral part of fire management. Means must be devised for two-way data communications to remote sites. Packet radio systems offer promise for providing this link. FLIPS is discussed in depth in the report (National Systems Management Review, 1/10/83 - 1/19/84, 1300/6600 cover letter from WO).

o BLM Initial Attack Management System (IAMS) provides considerable valuable information for fire managers. FS should devise and provide means to utilize this data via an IAMS/FLIPS interconnect.

o although not treated in depth in the 1972 Study, telephones remain an essential element in fire management. The impact of the court-imposed divestiture of the AT&T system, FTS, new technological developments, and many other telephone-related items are discussed in depth in the series of reports produced September 30, 1983, for FS by the National Telecommunications and Information Administration, U.S. Dept. of Commerce, Boulder, Colorado. Therefore, any update of the 1972 Study can draw on these NTIA reports. A means of interfacing telephones with radio systems should be provided (see item 7 below).

1/ Networking as used here means the bringing together of separate and diverse organizations and groups via a common communications protocol or language to facilitate understanding and coordination.

o although not technological per se, there has been a substantial reduction in in-house radio/electronics capability since the 1972 Study. In recent times FS has emphasized FLIPS, and radio has been deemphasized accordingly in many areas. Any update must consider this reduced capability (see item 15 below).

3. Provide guidance and standards to Regional Foresters for design and procurement of Forest net radio systems.

4. Provide guidance to Director, WO A&FM, for design and procurement of National Fire Radio Cache (NFRC) systems.

5. Provide guidance on replacement policy for telecommunications subsystems (ref. part IIIA, Vol. II, 1972 Study).

6. Reexamine preventive maintenance phaseout policy (ref. part III B, Vol. II, 1972 Study).

7. Provide guidance to Regional Foresters and NFRC for extending commercial telephone interface capability to remote incident sites by forest net/NFRC/microwave or other means.

8. Retain present NFRC frequencies for national use on major incidents.

9. Provide guidance to Regional Foresters on obtaining authorization for short-term (i.e. 2 weeks) use of radio frequencies.

10. Reexamine present national airnet system design with a view of replacing repeaters with links, thereby reducing use of one of the two frequencies now used.

11. Provide guidance on identification of radio frequencies used (i.e. direct readout of actual frequencies vs. channel numbers, etc.) including the effect on user programability. Reference FS BIFC NFRC 1/84 Operational Guide for 9600 channel radio use.

12. Specifically provide for and obtain current and continuing FS liaison with military telecommunications technology through FS participation in the Interdepartment Radio Advisory Committee (IRAC).

13. Obtain and exercise multiyear radio procurement authority (comparable to FLIPS procurement) to facilitate standardization of subsystems.

14. Any computer used in the Incident Command System must be compatible with X.25 (generic) or XODIAC (specific) protocol.

15. Examine consequences of reduced technical telecommunications capability at the Forest, Regional, and National levels in the face of increasing hardware and software complexity.

16. Examine capability of contract radio maintenance to respond to emergency incidents.

17. Consider use of predesignated, trained interagency communications teams to provide technical support to more complex incidents.

18. On an interagency basis, reexamine and strengthen Communications Officer qualifications and training requirements as the transition is made from the large fire organization to the Incident Command System; specifically include State personnel.

19. Provide for required update of any national telecommunications study at not more than 5-year intervals.

Required Outputs from Update
(not in priority order)

The update must provide these required outputs, as a minimum, but could provide additional outputs.

1. Validate adequacy of present NFRC design, including but not limited to:

- o numbers of frequencies, considering command, tactical, service, and air to ground
- o numbers of sets in each kit
- o numbers of kits, by category
- o contents of kits, considering data communications needs
- o radio/telephone interconnect capability.

This validation could be easily obtained by sampling one Class I fire overhead team per Region, giving six to eight sample responses.

2. Should future Forest and cache net radios provide channel numbers or direct readout of frequency numbers?

3. Should future Forest and cache net radios be user programable or technician programable?

4. What is the minimum required number of channels per Forest or cache net radio?

5. Provide frequency architecture for channeling purposes.

6. What should be the optimum battery pack configuration, considering custom dry packs, mercury cells, lithium cells, rechargeable NiCad cells, standard AA, C, or D cells, etc. This could be a productive cost analysis effort by MaSS or others with statistical capability.

7. Is there a need for one prototype portable 12-channel microwave system, to be used in a field evaluation mode? The outcome of the mobile service satellite issue presently before FCC will have a bearing on the microwave question.

8. Specify precisely those hardware/software/communications links that may be necessary to interconnect the data outputs of the BLM Initial Attack Management System (IAMS) at BIFC as inputs to FLIPS. Specify the hardware and software which would be needed for FS to use all or portions of IAMS at the Regional and Forest levels.

How to Accomplish an Update

The task group examined various methods of updating the 1972 Study, including:

- o assignment to FS Management Sciences Staff (MaSS, PSW)
- o contract to National Telecommunicatons and Information Administration (US Dept. of Commerce)
- o contract to a military agency such as USAF GEEIA or others
- o contract to private industry
- o in-house interagency task force.

Due to the perceived need to keep any update effort to the necessary minimum; the complexity of managerial, financial, and other organization considerations; and various other reasons, the task group felt the best choice would be a small interagency task force. In recommending this alternative, the task group felt that MaSS, who led the 1972 Study, should be involved in development of any detailed study plans for the update, plus being given the specific assignment for accomplishment of Objectives 5 and 6 from the above list. In addition, the task group felt that there may well be occasional need for small, short-term, hardware-related contracts to private industry as the update proceeds.

Task Force Composition

Since the update is basically a FS effort, the leadership and majority of the task force should be by FS. However, a key required principle is that the update absolutely must be done with the advice of USDI and NASF cooperators.

The task force should be made up of not over eight people selected from this list:

FS (not to exceed 6)

chairman: Ken Clark, R-5, or Fred Fuchs, R-6
members: Bruce Jacobson, WO CS&T (essential member)
Ken Quint, R-2
Les Helms, BIFC (essential member)
Harold Meade, Boise NF
Dale Matlack, BIFC, or Stan McGrew, R-4

In addition to the above, recent retirees such as Gordon Stevens, Ed Heilman, and others as volunteers could supplement FS efforts if needed.

USDI (not less than 1)

Dick Astley, BLM BIFC
Duane Herman, BLM BIFC
Ray Murray, NPS California Regional Office
Jerry Rauscher, BLM Idaho State Office

National Association of State Foresters (not less than 1)

Jack Peters, Montana Dept. of State Lands
John Crumb, Idaho Department of Lands
Don Pfohl, Oregon State Forester Office
Larry Neece, Washington Department of Natural Resources

Roles/Relationships of Related Organizations

Following are viewpoints and comments on a possible update of the 1972 Study from representatives of related organizations:

- FS WO Computer Science and Telecommunications - Beltsville, MD Electronics Center

- FS WO Aviation and Fire Management - Advanced Electronics Systems Development Group - BIFC

- FS WO A&FM - National Fire Radio Cache - BIFC

- BLM BIFC

- National Association of State Foresters

- Individual National Forest

from Bruce Jacobson, WO CS&T, 5/10/84

Beltsville Electronics Center Role in Update of 1972 Study

1. Provide current information on suitable radio types/costs available now and types expected to be developed in the near future by industry. This information to be used by MaSS to develop new figures to determine radio replacement policy.

a. Provide latest "contract" prices versus GSA prices to Team.

2. Provide technical information to update Team re: design tradeoffs and relative market strengths concerning synthesized radio. Example: number channels, frequency spreads, scanners, special functions, battery life to keep Team advised of alternatives available to support NIIMS.

3. Provide Update Team with an analysis of the benefits/deficiencies of contractor provided radio maintenance and breakdown repair based on past experience on selected Forests.

a. Propose a "best mix" of force account/contractor repair strategy based on Forest experience.

b. Provide analysis of depot maintenance versus field maintenance.

c. Economics of field parts, spares, stock versus spares policy - (working capital costs; interest rates; hand to mouth inventory of spares at factory warehouses; Japanese inventory/delivery method (just in time)).

4. Provide Update Team with current information re: packet radio and other new technologies on sending data over low power portable radio equipment. Demonstrate packet radio data link. Packet radio is an adaption of the X.25 data comm standard in a half duplex mode that allows push to talk control of a standard FM mobile radio.

5. Keep Update Team current on the mobile satellite system proposal before the FCC.

6. Develop analysis of alternatives of Forest radio replacement policies as they relate to operational readiness of Forest networks to support NIIMS.

a. Planned Forest by Forest system replacement.

b. Unplanned replacement of individual radios based upon financing opportunities.

7. Beltsville will study the multiyear radio procurement contract question and provide an analysis of the alternatives. A possible benefit would be a move towards standardization of mobile/portable units.

8. Provide Update Team with insight into where NTIA and the IRAC are headed re:

a. Amplitude Compandored Single Side Band (a narrowband modulation scheme permitting four users on one existing 25 kilohert FM channel. ACSSB is incompatible with all existing FM radio equipment).

b. narrow band FM

9. Provide listing of available and underused frequencies to support NIIMS such as:

a. Lo-band for packet radio data links to fire camps.

b. 902-928 mHz ISM band for portable microwave/links.

c. method of temporary (2 weeks) borrowing other agency frequencies on site specific basis.

10. Advise Update Team on Remote Automatic Weather Stations:

a. John Warren maintenance plan

b. Consolidated purchase

c. BLM - Duane Herman has maintenance costs
Phil Sielaf -- BLM BIFC has additional information

No policy from WO - was left to Regions and Forests.

<u>IAMS</u>

FS must be able to receive IAMS raw data (i.e. ALDS, RAWS, etc.) generated by the BLM Data General MV10000 located at BIFC.

Forest Service will need to sort this raw data by location, ship it to desired destination via FLIPS and display it on a suitable graphics output device compatible with the BLM Data General Model 20.

from John Warren, BIFC, 5/10/84

WO A&FM Advanced Electronics Systems Development Group

The Advanced Electronics Systems Development Group is part of the Aviation and Fire Management (A&FM) staff, stationed at the Boise Interagency Fire Center (BIFC), Boise, Idaho. The group leader reports to the Assistant Director - Operations, A&FM.

The group is responsible for the research, development, test, and evaluation (RDT&E) of various advanced electronics and infrared systems which are applicable or have potential for application to fire management. The group is responsible for systems engineering, technical procurement activities, systems integration, training, and technical consultation leading to full implementation and operational usage of the systems.

The developments may include special transmission/reception systems or use existing telecommunications systems. Such developments or usage are coordinated through the Beltsville Electronics Center for frequency management needs.

The primary mission is to develop and apply advanced electronics technology for fire management uses, although nonfire use may also be inherent in many of the systems. Nonfire developments may also be conducted if approved.

The group works in accordance with its mission, charter, and responsibilitites document and a 5-year plan approved at the national Aviation and Fire Directors' Meeting and updated annually.

Although the group may develop/evaluate special systems that involve Incident Command Post transmission/reception capabilities, those activities do not usually include either Forest or NFRC two-radio communications. The group is evaluating various satellite links for ICP communications which may include voice/data/video, including potential for IR image/data transmission/reception. The group will coordinate as required and is available for technical consultation during the course of the update of the 1972 Telecommunications Study and draft review, but other participation should not be necessary for completion of the update.

from Les Helms, BIFC, 5/9/84

WO A&FM National Fire Radio Cache

The 1972 Telecommunications Study still has merit with reference to large fire organizations as we know them today, but with new technology and with the implementation of the National Interagency Management System (NIIMS) in 1985, we see a need to update the 1972 Study to:

1. include current and near future technology into the large communication systems, logistic support nets, and support equipment.

2. reassess the cache requirements to support NIIMS and recommend changes and additions to meet future needs.

To assess the present cache configuration size and for updating the 1972 Study we (the May 1984 Task Group) recommend that the Telecommunications Study Update Team take a look at:

a. The number and size of large fire communication systems; the need for spare tactical radio kits and repeaters to support the large systems during larger incidents and to support smaller incidents such as floods, law enforcement and the Three Mile Islands rather than break up large systems. The cache has also been called upon for miscellaneous radio kits to support heavy ABC suppression.

b. Number of logistic systems and their radio complement. The nine logistic systems do not fully complement the large systems or fire needs.

c. Radio/telephone systems to support National needs, how many? Plus number of terminals per large incident?

d. Data terminal requirements to support large incidents. Data terminals will reduce logistical support air time and provide more accurate ordering.

e. Radio link systems, UHF, and low band to support incident needs.

f. How to best provide netting or interfacing communication ties with other agencies during suppression of multiagency incidents?

g. Should NFRC stay with the present 8 channel radio frequency complement or go to an 80 plus channel radio?

h. How can we provide frequency management with multichannel radios and how should they be channeled to meet large incident needs.

i. The use of available Regional and Forest microwave systems in conjunction with NFRC logistic nets to provide long haul hops between remote incident command and the outside world. How can we best provide communication netting on interfacing between the two systems.

j. Look at the present cache workload and any additional workload that may be created by equipment additions recommended by the Study Team; person years needed for systems buildup, winter maintenance and fast turnaround of systems, plus inventory, packing, cleaning and shipping of equipment.

k. Recommendations on satellite communications for logistical support.

l. Look at how we may provide qualified personnel staffing to install the more complex voice/data/radio and telephone systems?

1) By assigning Regional, Forest, and other agency personnel to NFRC to learn how to set up and use the different types of systems, the trained personnel would then be assigned to a Comm Tech Team for dispatching from their home station when a cache system is dispatched to an incident. The person(s) would then be assigned to the communication unit leader for the purpose of setting up and installing the equipment, or

2) By assigning trained Comm Techs to NFRC staff to travel with communications systems.

m. Recommendations on budget requirements for the cache to include any additional equipment add-ons and personnel staffing. We presently have an 8-year cycle replacement program.

n. At the present time there is no funding replacement program for the 9600 channel radios, nor is there a recommended replacement cycle.

o. The NFRC systems should be designed to meet Forest Service needs and maintain compatability with the BLM cache.

p. There is also a need to develop a communication officer course with enough meat so that the course may be taught at the Regional level and still maintain standardization.

from Duane Herman, BLM BIFC 5/10/84

BLM BIFC

1. Both the Forest Service and Interior radio caches should be able to serve large incident communication needs as individual entities. However, both caches should retain sufficient compatibility so they can be integrated into one system on a multiple incident.

2. BLM, BIFC training personnel will have to be part of any effort to establish a USFS national level Communication Unit Leader course if that course is to include National Radio Support Cache equipment.

3. BLM, BIFC has a cadre of communication technicians, with fire experience, who, in conjunction with Forest Service personnel could be utilized, on a limited basis, to aid in field testing new communication technologies. This type of effort could lead to a level of cooperation and exchange of information that might keep each agency from inventing a similar but incompatible wheel.

4. A joint effort on the part of BLM and USFS will be required to solve the fire communication problems that have been brought to light as a result of the move toward implementing the Incident Command System.

5. In the Incident Command System, there are many areas where qualification and or training levels are left up to the discretion of the individual agency and referred to as agency specific. In the area of large fire communications the Interior and USFS agency specifics should, at the least, closely parallel each other.

6. BLM, BIFC is not involved with Bureau initial attack communication systems so will be limited in the ability to respond or assist with information concerning activities or efforts in that area of fire communciations. The BLM Washington Office, Division of Information Systems, is the proper contact point for information or coordination regarding permanent land mobile radio communications.

7. The Initial Attack Management System (IAMS)

The Initial Attack Management System (IAMS) is a large computer based wildfire management system that covers all of the Bureau of Land Management lands in the contiguous 11 western States. It is the integration of two existing fire management systems (the Automatic Lightning Detection System (ALDS) and Remote Automatic Weather Station (RAWS) System) with several extremely large computer data bases, fire and resource management software packages, and a bureau wide satellite based fire fuels mapping project. The goal of the IAMS system is to provide the local district and State fire managers all the fire related management information they need, in real time, on which to base their fire suppression decisions. In addition, this system will provide a means for short and long range fire and resource management planning and research. All of this data will be available through a network of Remote Intertactive Graphics Systems (RIGS) (desktop minicomputers*) located in each of the Bureau's district and State fire management offices. Each RIGS will be permanently connected to the central computer system located at BIFC.

The IAMS was designed with a 9600 BPS "output port" that would feed the ALDS and the RAWS data to other using agencies. This information will be paralleled off at the IAMS distribution front end at BIFC. A using agency would then be responsible for the interfacing with the IAMS output port, pulling off the ALDS and the RAWS data and distributing this information to their various field offices. If a using agency wishes their field offices to have "REAL TIME" archive retrieval of this data, and they do not have access to an IAMS Remote Interactive Graphics Terminal, then they would have to configure their sites to handle this.

* Data General Model 20 Visual 500 display terminal, Anadex Graphics printer

from Jack Peters, MDSL, 5/10/84

National Association of State Foresters

The States role in the Forest Service telecommunications planning update should be one of conveying the various needs and requirements of the individual State agencies to the planning process so as to maximize the cooperative effort in telecommunication usage between agencies.

The individual States requirements vary in their complexity and in their necessity for involvement in the Forest Service planning process. The primary input should come from the wildland fire related State functions and reach as many States as possible that have wildland fire protection responsibilities intermingled with Forest Service protection. The State involvement should be as intensive as possible so as to address those areas where increased cooperative effort will minimize costs and maximize efficiency to all agencies involved.

State involvement should be continuous through the representation of a State individual on the Update Study group selected. Additional input should also be obtained from the State agencies through a predetermined process of periodic review of the developing telecommunications plan. This would provide additional input that may not be readily apparent from the State representative and also allow the individual States to update portions of their own telecommunications plans to coincide with the Forest Service plan, if it is appropriate and advantageous to do so.

The following portions of the Forest Service plan update may be of concern to many State agencies and their input should be stressed.

1. Frequency Utilization - Each agency utilizes preassigned portions of the radio spectrum for their specific operations. Individual agency operations will be maintained but to enable State and Federal two-way communications during fire suppression activities, cooperative radio frequencies should be identified.

2. National Fire Radio Cache - The eventual replacement of existing portable radio units with 24 mHz spread units would allow increased flexibility in their use by other Federal, State, and local agencies.

3. Forest Net Radio System - Radio units purchased at Forest level operations should have the capability to communicate with State radio equipment and vice versa. This would help reduce costs and confusion during initial attack operations for both agencies. Also, increased use of joint field operations radio equipment would reduce the need to utilize centralized caches for medium fire actions.

4. System Networking - Many States have or will be developing communications systems throughout their areas of fire protection responsibility. Coordination and cooperation between agencies would reduce costs and increase overall efficiency. Examples may be shared microwave links, repeater/mobile relay sites, and frequency trunking.

5. Computerization - The use of computers in both the fire camp and throughout the agency offices should be coordinated as much as possible and practical. Data transmission between agency computers will reduce errors and speed up information exchange.

6. Communications Officer Training and Qualification - Forest Service and State communications personnel should be trained jointly to increase the availability of a currently limited personnel resource for all agencies with their own communication systems. This would allow the possible formation of communication teams for large fire use.

7. IAMS - The incorporation of IAMS into the Forest Service plan update should be a priority consideration by the planning group. The benefits would be as important to the State agencies as it is to the Federal. The ideal, at this time, seems to indicate the use of the Forest Service FLIPS to distribute the information to as many users as possible in a short time. State agencies would then either have to incorporate Data General equipment or disseminate information from a centralized location into their own data transfer systems. Determination would have to be by each individual State agency on how they would utilize information if it is readily available to them. The FLIPS network offers the widest area of coverage to the States at this time and seems to be the logical system for cooperative use. Individual State access and use would need to be established through cooperative agreements.

Additional areas of input need by the States will become more readily apparent as the Forest Service planning update progresses.

Suggested State Update Review Method

Announce decision to proceed with update of plan to NASF Communications Committee, Chairman Michael P. Mety, Louisiana State Forester. If jointly desired by Mety and Chief, suggest FS update be announced by NASF at 7/84 FCCA meeting at Peoria, Illinois.

In addition, supply information through FS S&PF fire personnel to make contact with State fire personnel on input information.

from Gordon Stevens, Boise, 5/8/84

Evaluation of 1972 Telecommunications Study Update from an Individual National Forest Standpoint

Implications of National Forest communications systems, relation to project fire management, and coordination with cooperating agencies.

The most important single concern at the Forest level is maintaining an adequate maintenance capability. Maintenance and installation of telecommunications equipment may be through in-house Forest technicians, zone people, contractors, or a combination. But whatever the approach, enough capability has to be available to the Forest to insure that a quality job is being done. Future decisions should be based on an analysis of the workload and a task analysis to determine what skills are needed.

If contracting is selected as part of the solution, someone on the Forest or zone must be able to properly administer the contract. Whenever installation of new or replacement equipment is planned, the cost and labor to install the equipment must be planned and financed.

Much of the general preparation can be handled in a Forest Telecommunication Plan. An approved plan should be a requirement before money is allocated to installation of equipment.

Another important justification for quality people at the Forest level is the need to provide for fire and other emergencies. A communication team can be called during a large incident, but they are not a substitute for the routine fire suppression or rescue job. Also, an Incident Commander needs to draw heavily on the local knowledge of terrain and relationships with cooperators.

The Forest telecommunications system, involving telephone, radio, and data has to be able to handle routine traffic and frequent, short duration incidents. This includes administrative traffic, aviation communications, initial fire attack, and support for a large incident while awaiting the delivery and management of an incident radio cache.

Much efficiency of operations can be attained by cooperators working together in using each others equipment and sharing frequencies. Also in joint construction of antenna towers, photovoltaic power systems, and radio buildings. An additional benefit is achieved when a multijurisdictional incident requires common communication capability. The need for this is usually at the time of an emergency when plans should be quickly implemented rather than prepared.

The Forest Service should recognize and develop ways to recruit and train young electronic technicians to fill the jobs described above. Most Forest electronic techs are approaching retirement age, leaving a void in the organization to provide the needed skills. The study should show the number and qualifications of people needed.

Development of a Forest system to meet future needs must be in harmony with the Regional backbone system. It must consider all methods of communication, and current and future equipment available. It must be flexible enough to accommodate new technology constantly becoming available. It must be simple enough that users can handle it with a normal amount of training. It must be compatible with neighbors and large incident communications systems. It must be designed and documented so that new technicians can service it without spending a lifetime in orientation. It must be reliable enough to stand ravages from weather, vandals, isolation, and poor access.

Timetable

Item	Date
1. Management decision(s) on this report	June 30, 1984
2. Task force charter finalized	July 30, 1984
3. Task force appointed	July 30, 1984
4. Data needs determined and published	August 30, 1984
5. Task force organizational meeting	After Oct. 1, 1984
6. Task force meetings, staff work	Before Dec. 15, 1984
7. First review, draft of report	March 30, 1985
8. Draft report to field and cooperators for review	April 1, 1985
9. Review comments to task force	June 30, 1985
10. Revise value analysis, produce final draft	July-Sept. 1985
11. Final report to Chief	September 30, 1985
12. Implementation	F.Y. 1986+

Cost Estimate for Study Update

Unless some greater need occurs, the update task force should normally hold their meetings at BIFC. This relatively central location provides good meeting facilities and office support systems plus ready access to many specialized disciplines such as the FS Advanced Electronics Systems Development Group, BLM Information Systems Management, FS and BLM fire radio caches, FS and OAS aviation managers, FS and USDI Logistics Support, etc. National Forest and BLM State Offices are also at Boise.

Travel cost estimates are based on a BIFC meeting location.

	Item	Estimated Cost	
1.	Task Force time		
	a. Team Leader 5 pp @$2,000	$10,000	(contributed)
	b. Team Members 7 ea x 4 pp @$1,600	44,800	(contributed)
	salary subtotal	54,800	
2.	Consultant time		
	5 days @$300	1,500	
3.	Travel Per Diem		
	a. 2 Team Leader trips to WO @$1,000	2,000	
	b. Task Force travel to and from BIFC 4 trips x 6 people x $500	12,000	
	c. Per Diem 8 people x 20 days @$60	9,600	
	d. Consultant Travel	500	
	travel subtotal	24,100	
4.	Misc. Hardware Purchase, small contracts, etc.	5,000	
	subtotal	85,400	
5.	Contingency for unforeseen events (10 percent of itemized entries above)	8,500	
6.	Total	93,900	gross
		-54,800	contributed salaries
		$39,100	net project cost

This cost estimate does not include any costs at the unit level for providing data required by the task force, reviewing draft reports, or any other form of response to the task force. No implementation costs are included.

(end report)

United States Department of Agriculture | Forest Service | WO

Reply to: 7200/5100 Date: March 31, 1986

Subject: Cache Sizing for Large Fire and Logistics Systems

To: Regional Foresters and Area Director

We have reviewed field input on the National Fire Radio Cache sizing recommendations prepared by the National Incident Communications Study Team.

We are adopting the team's recommendations and all future shipments of NFRC Systems and Logistic Nets will be sized to starter systems. The equipment catalog is being revised and should be available by May 15, 1986.

The enclosures provide a comparison of Large Fire Systems and the new Starter Systems.

If you have any questions on the systems, please contact Les Helms at WO2A or FTS 554-9885 or COM (208) 334-9885.

/s/ John w. Chambers

JOHN W. CHAMBERS
Acting Director A&FM

Enclosures

Appendix Item B

NATIONAL RADIO CACHE SYSTEMS

The National Fire Radio Cache has been directed to reformat all Large Fire Systems and Logistic Nets.

The new systems will be called ICS Command Systems and ICS Logistic Nets respectively.

Total number of modules, weight and cubic feet will change as follows:

From Large Fire System		to ICS Command System.
Modules:	16 each	to 5 each
Weight:	1,350 lbs (Average)	to 520 lbs (Average)
Cubic Ft:	54	to 17.5

From Present Logistic Net		to ICS Logistic Net.
Modules:	5 each	to 3 each
Weight:	490 lbs	to 280 lbs
Cubic Ft:	17	to 10.5

NATIONAL FIRE RADIO CACHE

LFO Systems Vs. ICS Systems

	LFO System	ICS System
Base Camp Radio Kit	1 (12 ea)	0
* Base Stations	3 (1)	1 (1)
* Public Address	1	0
Base Camp Repeater	1	1
* Tactical Special Repeater	1	0
Accessary Kits	2	0
Tactical Division Radio Kit	3 (16 ea)	3 (16 ea)
* Tactical Special Radio Kit	1 (16 ea)	0
VHF-AM Aircraft	1	1
Antenna Installation Kit	1	0
** Comm. Unit Leader Kit	1	1
Total Kits:	16	7
Total Radios:	76 ea	48 ea

* Kits removed will be maintained as support kits and may be ordered as needed to supplement the ICS Systems.

** Comm. Unit Leader Kit will be shipped inside the lowest numerical numbered Tactical Division Kit.

NATIONAL FIRE RADIO CACHE

LFO Logistic Nets Vs. ICS Logistic Nets

Old Net	~~New Net~~ old	New Net
Base Camp Radio Kit	1 (14)	1 (16)
Base Camp Base Station	3	1
Base CAmp Repeater	1	1
Total Kits:	5	3
Total Radios:	14	16

Kits removed will be maintained as support kits and may be ordered as needed to supplement the ICS Logistic Nets.

AGREEMENT TO SHARE
RADIO FREQUENCIES BETWEEN

_____

AND _____

The purpose of this agreement is to provide for the sharing of specific radio frequencies that are authorized/licensed to each agency. This agreement is needed to provide efficient, cost effective radiocommunications support in protecting life and property under the management of the agencies making this agreement.

This agreement to share certain radio frequencies is entered under the authority of the NTIA Manual of Regulations Sections 7.3.1, 7.3.4 and 7.5.1 and FCC Rules and Regulation Part 90, Sections 90.405 and 90.407.

The parties to this agreement hereby agree that the following conditions are to govern the mutual use of their respective radio frequencies identified in an attachment to this agreement:

1. Each agency shall exercise control and be responsible for all radio transmissions on their authorized/licensed frequency. It shall be possible to immediately terminate the use of a specific frequency when it is deemed necessary by the controlling agency.

2. Local dispatch and management procedures between the agencies of this agreement will be used to provide for orderly control of each other's frequencies.

3. This agreement is for mobile, portable, and transportable radios only. Permanently installed base stations are not included in this agreement.

4. A radio frequency list for each agency is attached identifying the operating frequency, power output limitations, operational use area, agency contact point, and other operational information regarding the use of the frequency.

5. Use of the listed frequencies under conditions other than identified in this agreement will be reported as interference, and appropriate action taken.

This agreement may be modified by written amendments with the mutual consent of the agencies.

Unless otherwise provided, this agreement continues indefinitely and is effective as of the date of signatures. A party can terminate this agreement by providing 30 days written notice.

Agency _____ Agency _____

Signed _____ Signed _____

Title _____ Date _____ Title _____ Date _____

Agency _____ Agency _____

Signed _____ Signed _____

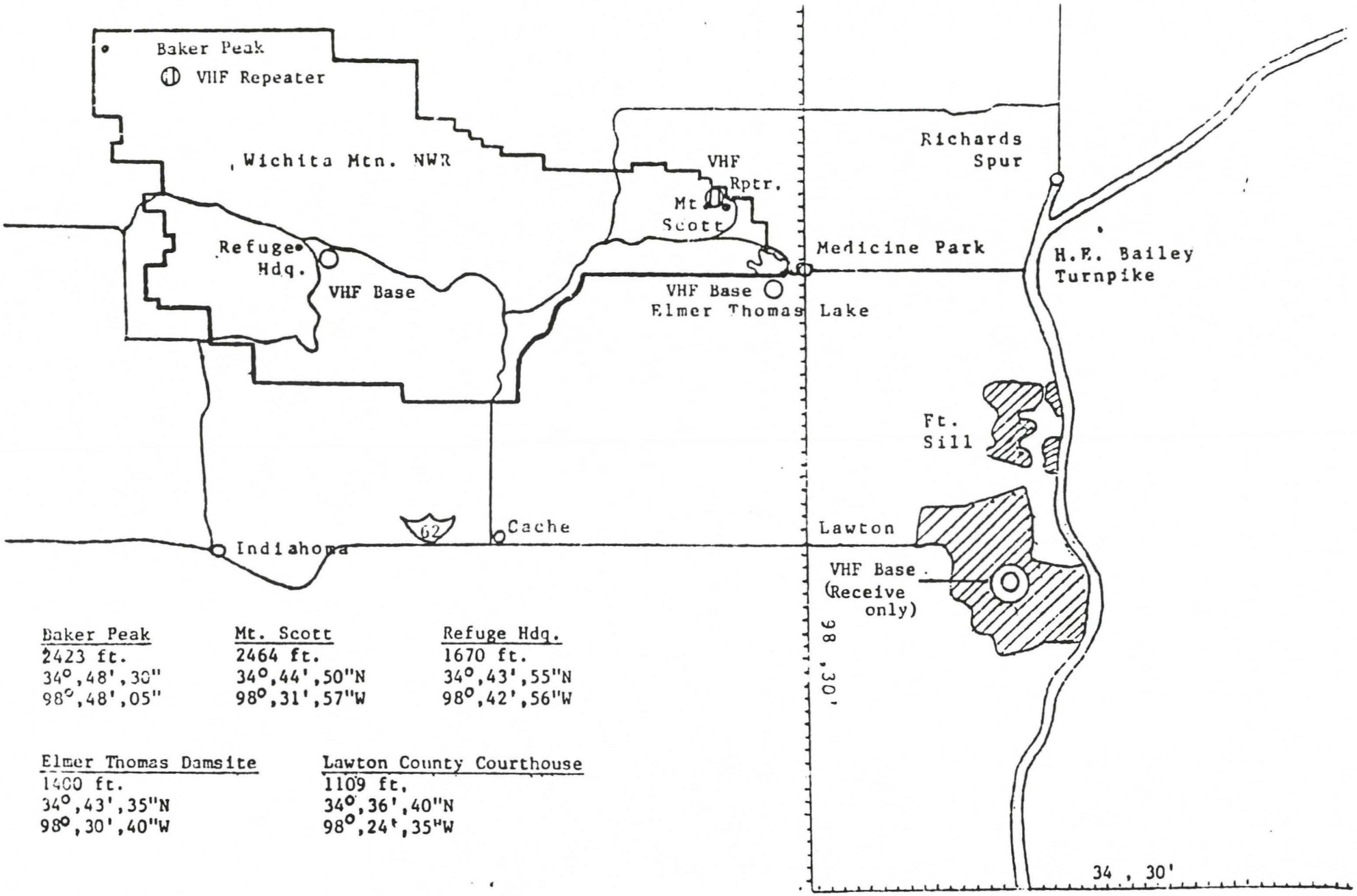
Title _____ Date _____ Title _____ Date _____

USDA Forest Service authorized radio frequencies identified for shared use under the provisions of this Agreement.

Area of Operation	Agency Contact	Frequency	Power Output Limit	I.D.	Operational Guides
Corona NF	Corona Dispatch North Pole (907)555-1111	164.999 MH_z	100 WATTS	Fire One	
		166.999 MH_z	100 WATTS	Forest 3	FPT Contact Freq.
Artic Circle	Artic Dispatch Iceberg (907)556-2222	165.999 MH_z	100 Watts	TAC 6	BIFC Cache frequency
Point Barrows	Corona Dispatcher North Pole (907) 566-1111	167.99 MH_2		Forest 2	Repeater access to Mt. Diapointment
Alaska	Cache Supervisor BIFC (208) 334-9999	168.999 MH_z	10 Watts	BIFC CMD 7	Obtain clearance from BIFC

SAMPLE ATTACHMENT

3237p

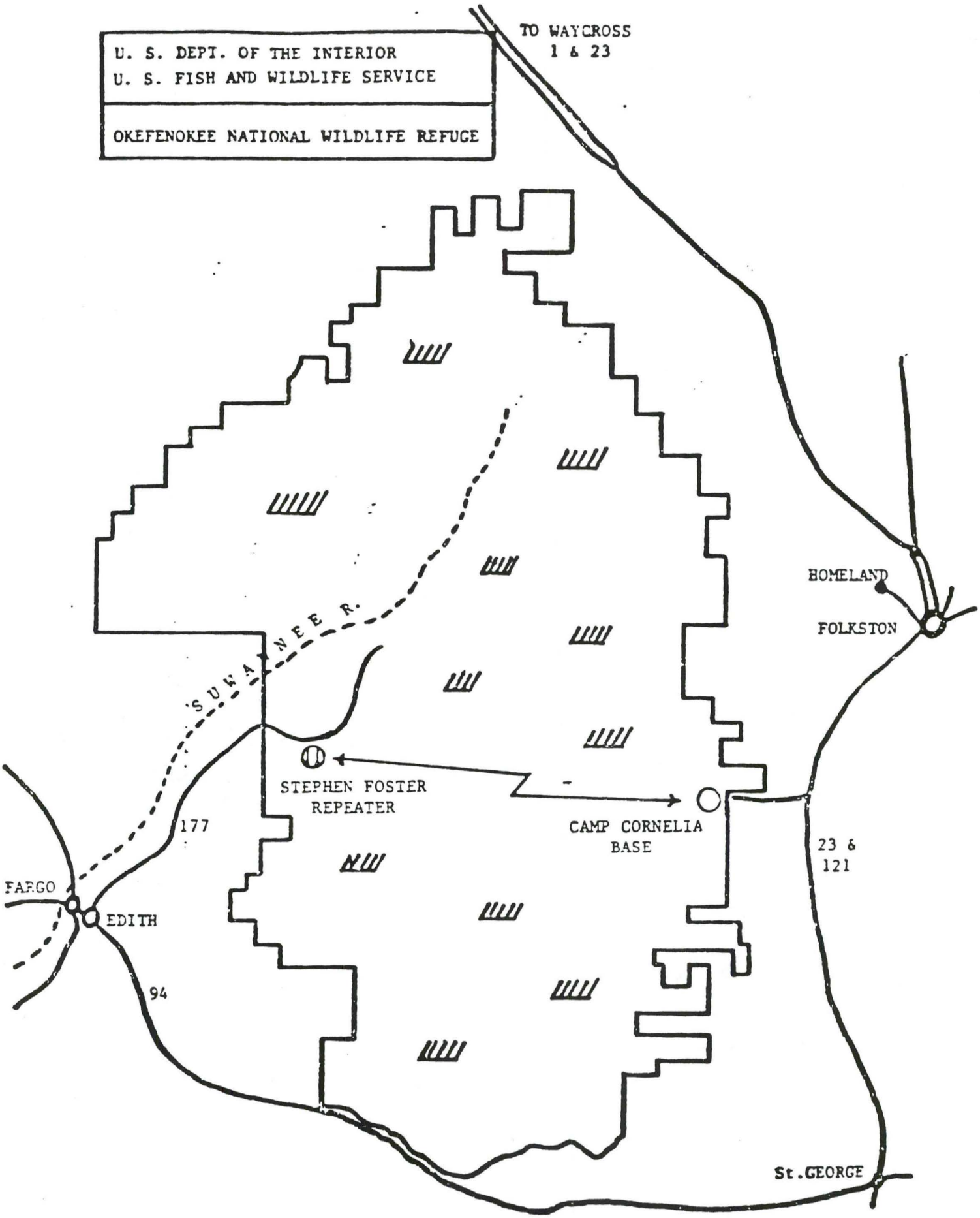


Baker Peak	Mt. Scott	Refuge Hdq.
2423 ft.	2464 ft.	1670 ft.
34°,48',30"	34°,44',50"N	34°,43',55"N
98°,48',05"	98°,31',57"W	98°,42',56"W

Elmer Thomas Damsite	Lawton County Courthouse
1400 ft.	1109 ft.
34°,43',35"N	34°,36',40"N
98°,30',40"W	98°,24',35"W

Frequency Range	Repeater	Base
VHF	⊟	○

Wichita Mtns. National Wildlife Refuge
Indiahoma, Oklahoma


U. S. DEPT. OF THE INTERIOR
U. S. FISH AND WILDLIFE SERVICE
OKEFENOKEE NATIONAL WILDLIFE REFUGE
TO WAYCROSS
1 & 23
HOMELAND
FOLKSTON
SUWANEE R.
STEPHEN FOSTER
REPEATER
CAMP CORNELIA
BASE
177
23 &
121
FARGO
EDITH
94
St.GEORGE

Kutter Clark - Ag FM

UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

RO

REPLY TO: 7200

DATE: June 18, 1986

SUBJECT: Programmable Radios

TO: Forest Supervisors and RF Staff

Our letter of April 14 called your attention to the potential unauthorized use of radio frequencies, due to the ease with which the new hand held portables can be programmed. Potential abuse of radio frequencies assigned to wildland fire agencies is becoming an increasingly sensitive issue, and could jeopardize our frequency authorizations for fire emergencies, if we fail to manage our responsibilities properly.

Potential abuse is not limited to unauthorized progamming of hand held portables, as the multi-channel mobiles and portables now in use contain frequencies that are authorized in limited geographical areas, and their use outside of those areas is a violation of Federal Regulations. We had one example in 1985, where one of our crews was assigned to a fire in Region 4, and used their forest frequency for an intra-crew channel on the fireline. That frequency was shared by another R4 forest, and they experienced unwarranted interference. That incident was easily resolved, but if we had interfered with another federal agency, the consequences to our frequency authorizations could have been serious.

We urge you to emphasize proper frequency management and user discipline in your training of personnel assigned radios. Our people who operate multi-channel radios have demonstrated proper management in the past, and we should continue to manage this new technology with the same professionalism.

We recognize that indiscriminate programming is only one aspect of potential abuse. We also recognize that selected personnel may also have a legitimate need to reprogram a radio without the availability of an Electronic Techinician. Forest Supervisors are authorized to delegate responsiblity for progamming radios to designated individuals, as documented in the unit Communications Plan. The Communications Plan must provide the assurance of proper use and

management for frequencies and programmable radios. We envision this authority limited to a select few, such as a Smokejumper Foreman or supervisory law enforcement personnel. The bulk of radio programming would be done as described in our April 14 letter.

Ernest T Tolin

ERNEST T. TOLIN
Assistant Regional Forester
Information Systems Management

FS-6200-28(7-82)

(1)

United States Department of Agriculture | Forest Service | WO

Reply to: 5130 Suppression
7200 Communications

Date: MAY 10 1982

Subject: National Aircraft Radio Frequency Use

To: Regional Foresters

Increased air-to-air and air-to-ground radio use on fires when aircraft are utilized has increased the problem of overloading aircraft frequency use. This was discussed at the Regional Air Officers Meeting in January 1982 at Denver, Colorado. It was determined that these aerial communication problems needed to be corrected to provide safe aviation operations in our fire suppression work. A work group was convened at BIFC, April 14 and 15, to review the problems and develop new direction in use of aircraft-related frequencies in fire suppression activities. This direction is enclosed and will be reflected in FSM 5130 and in FSM 7200.

WALLACE R. OTTERSON
Associate Deputy Chief

GARY E. CARGILL
Associate Deputy Chief

Enclosure

Limited Distribution

USDA

Appendix Item E

NATIONAL AIRCRAFT RADIO FREQUENCY DIRECTION

Airnet (168.625) is a guard frequency to be used only for emergency radio traffic to/from an aircraft. It is very similar to 121.5 mhz emergency frequency in civil aviation and 500 and 2182 Khz for marine distress. It is the Forest Service "Mayday" frequency used in fighting fire and other aviation-related activities. Its primary function is prevention of incidents or loss of life. Every aircraft and many portable radios used on the fire-line are equipped with it so that unsafe operational conditions can be avoided. Any activity on this radio channel should be recognized as an immediate emergency requiring instant reaction to avoid an accident or possible loss of life. Examples might be helicopter evacuation of a trapped crew, medivac of an injured person, or correction of a misdirected aerial delivery. In order to fulfill this essential mission, Airnet must be kept free of all operational radio traffic and monitored by all aircraft, dispatchers, and the radio operators on the fire.

This "Mayday" frequency is being congested with routine, but necessary air operational fire traffic. As a result, pilots and air attack bosses turn down or turn off the guard channel as the frequency becomes overloaded in the area. The problem has become of sufficient magnitude to have nearly paralyzed the effectiveness of the air operation at times.

To correct this deteriorating situation, the following actions must be taken immediately:

1. Restrict all use of Air Guard (168.625) to:

   a. Genuine emergency use between aircraft and fire ground crews and aircraft.

   b. Correction of aerial delivery.

   c. Emergency contact with aircraft to net him on proper frequency

   d. Very long distance dispatch/recall/redirection of aircraft that have exceeded range of other dispatch capabilities.

2. Regional and Forest dispatchers and air service managers may use 168.650 to provide local air control and dispatch/recall/redirection of the aircraft in those situations where the local Forest net frequency proves too congested.

   This frequency (168.650) will not be used as a repeater output frequency, but may be utilized in a UHF-link controlled or wire-controlled hilltop installation with a suitable reduction in power.

   The intent is local rather than Region-wide coverage, and may be implemented immediately with followup frequency request action.

3. To provide air-to-ground tactics channels for close air support. The four air-to-air frequencies--166.675, 169.150, 169.200, 170.000--may also be used for air-to-ground-to-air communications.

   Radios will be furnished with the NFRC systems to provide the key ground fireline persons with these frequencies. Use of these radios should be restricted to fire boss, line boss level.

   A small scanner will also be supplied as part of the Tactical Special kit as soon as funds permit.

   By including ground radios on the air tactics frequencies, the voice repeated function and channel switching in the aircraft should be reduced. This should result in a smoother air operation.

4. The frequency of 122.925 may be used at any time by any natural resource agency for all communications, U.S.-wide. The frequency of 122.900 and 122.850 are also available to all pilots for air-to-air communications. These are heavily used and should only be used as a last resort during fire.

   To provide additional VHF-AM aircraft channels, the following frequencies have been coordinated west of the Mississippi River with FAA and FCC.

   The following three frequencies have been coordinated with the FCC and may be used only on wildfire activity. These may be used air-to-air and air-to-ground until December 31, 1983: 122.975, 123.050, and 123.075.

   The following two frequencies have been coordinated with the FAA for use only on wildfire activity for air-to-air and air-to-ground, expiring December 31, 1982: 118.550, and 135.975.

All of these channels are shared with the general aviation community with the exception of 122.925, which is shared with all other natural resource agencies. Please be courteous to other users as these are not clear Forest Service frequencies.

To gain an additional clear VHF-FM frequency, the long range strategy is to eventually replace the existing air net repeaters with UHF-link controlled base situations where necessary as rapidly as funding permits. This will free 168.025 for future reassignment as Guard II in those areas experiencing Mexican interference or for use as air dispatch. This needs to be coordinated with the BLM.

COMMUNICATIONS PLAN-AIR OPERATIONS

The communications plan for incident air operations should center around the Air Attack Supervisor. The design of the plan should divide the communications net to enable the Air Attack Supervisor to monitor the least number of channels and still have ready access to the whole air operation. Conservation of frequencies and comm equipment and increased efficiency of operation is the primary purpose in making these changes.

The proposed system is outlined as follows:

AIR ATTACK SUPERVISOR

In all instances, Air Attack should monitor the primary command repeater channel. When Air Attack wishes to contact Operations personnel on the ground, he would make contact via the VHF Command Repeater, then advise the party to switch to the proper TAC channel to carry on the conversation. When the conversation is finished, Air Attack will resume monitoring of the Command Net and advise the ICP that he is back on the repeater.

Air Attack will communicate with the Lead Plane by either an FAA locally approved AM frequency, or one of the approved National Air Net Channels. Lead Plane to Tanker traffic will also be on this channel. Only Air Attack should communicate with the Lead Plane; only the Lead Plane should communicate with the Tankers. Air Attack will contact Tactical Helicopters on 122.925 AM or as assigned.

OPERATIONS

Operations will contact Air Attack via the Command Net, then switch to the appropriate TAC channel to converse.

Operations will contact Tactical Helicopters via the TAC channel assigned to the area in which they are operating.

Operations can contact Air Support (Helibase) via Command Net.

TACTICAL HELICOPTER OPERATIONS

Flight Following (Collision Avoidance)

This channel will be 122.925 AM at all times unless the close proximity of air operations on adjacent incidents requires another to be assigned. Heliport/Helispot traffic will also be on this channel ONLY WHEN ACTUALLY COMMUNICATING WITH AIRCRAFT. Non aircraft traffic will not be conducted on this channel.
(When possible, 720 channel AM radios will be provided to Heliport/Helispot personnel for the purpose of communicating with aircraft. When these are not available,

an aircraft base station will be provided.

HELIPORT/HELISPOT NON AIRCRAFT TRAFFIC

Heliport to Helispot traffic, or Helispot to Helitack traffic will not be conducted on an AM aircraft channel. Instead, a separate system will be provided as follows:

A. Separate repeater(UHF or VHF) for air support use only.
B. Separate radios not requiring a repeater for air use.

This will prevent routine logistical traffic from interfering with the flight following channel.

SPECIAL OPERATIONS (Helitorch, etc.)

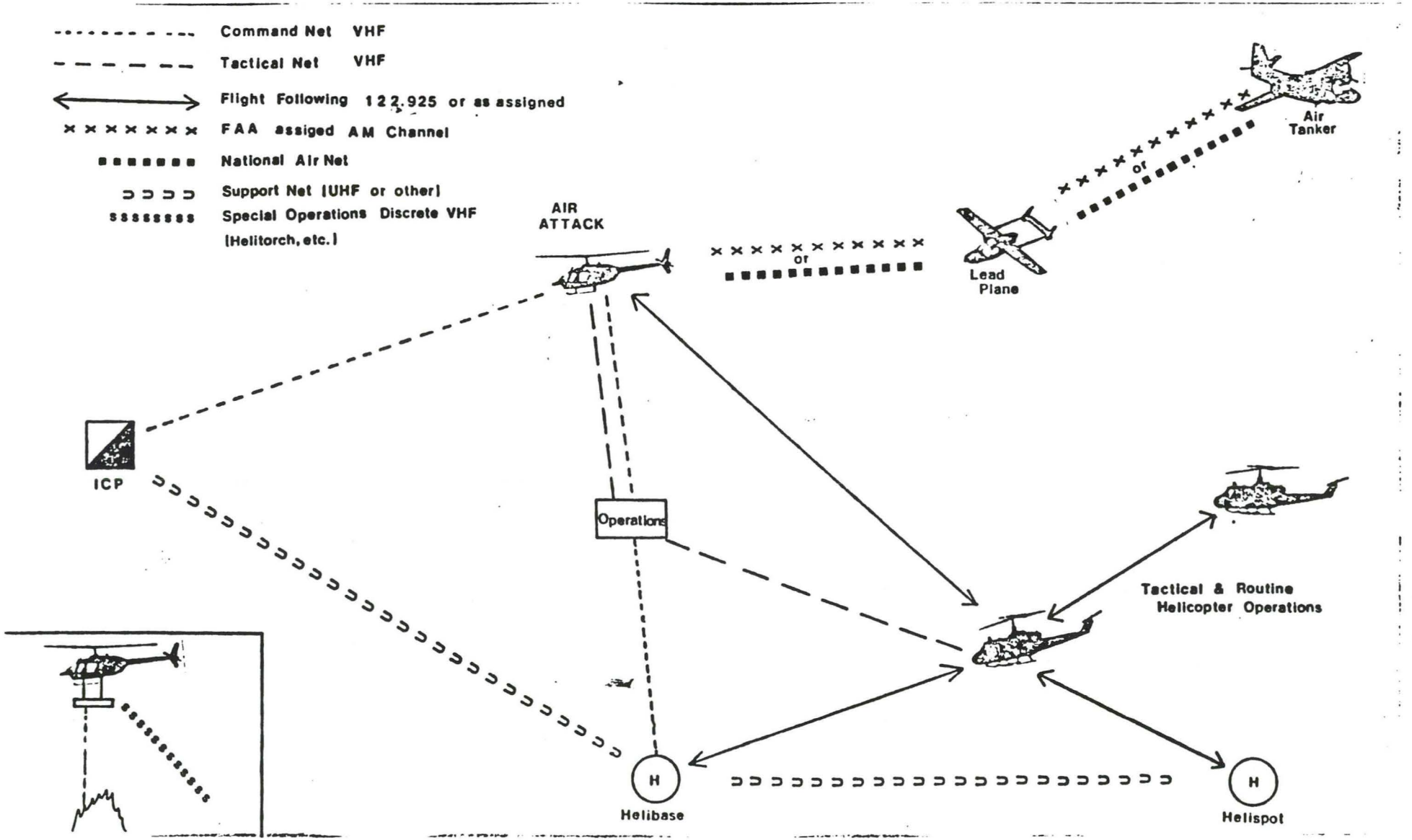
Helitorch and other special operations require, by regulation, a discrete channel. This can be accomodated with an approved National Air Net/Special Ops VHF channel, and operate independently of the Air Ops Comm Plan. In this manner, an Operations person on the ground may direct helitorch operations with a VHF hand held radio, through the FM multichannel radio in the Helitorch ship. If terrain/line- of-sight limitations are a factor, an AM/FM mountaintop link can be utilized to allow the use of a TAC channel to communicate through the aircrafts' AM radio.*

* This system should only be used when actually required, as it has two disadvantages: Depending on the radio cache equipment in use on the fire, it can use up one of the TAC channels that may have been in use elswhere, and it requires the Helitorch ship to monitor two AM frequencies; one for flight following, and one for helitorch operations.

SPECIAL NOTE: In the past it has been common practice to utilize 122.9 AM as a general purpose aircraft channel since it was unassigned by the FAA except as an air/air Multicom frequency. We find that this is now unadvisable, since the FAA has directed that pilots approaching or departing uncontrolled airports without manned Unicom (122.8) will broadcast in the blind on 122.90. Since most air to air traffic and all blind advisory traffic will now be conducted on the 122.9 Multicom channel, confusion may exist if this frequency is used as an Incident Air Channel. Other AM air channels are now available to use in its' place.

SINGLE INCIDENT COMM PLAN

ICS AIR OPERATIONS



EXPANDED AIR OPERATIONS

The complexity of the air operations in some of the larger incidents have taken the basic air attack structure a level or two higher than it normally functions at. The Air Attack/Air Operations structure is designed with the concept that it must support a large, multi-zone Class 1 Incident, and within that scope is quite flexible.

Consider, however, the effect of increasing this incident to an Area Command type of management. If the trend is toward larger incidents and more complex echelons of management, the air operations sector must be educated in the flexibilities and variables possible within the system. Also, the existing system capabilities must be expanded to meet the increased demands ofthis type of operation.

In this complex a situation, there are more factors to be considered than just the communications plan. Also involved are airspace closures and restrictions, the pros and cons of creating restricted airspace along Victor Airways, assigned entry and exit flight corridors for air tankers, holding pattern altitude assignments, overall airborne air traffic coordination, and centralized retardant ordering procedures, to name only a few.

When aircraft from more than one ICS Team are operating in common airspace, when separate incidents are receiving retardant from the same Tanker Base, when one complex is ordering retardant from two or more Tanker Bases, or when multiple Air Attack organizations are functioning with common resources, the exposure to risk can be very high if a well defined communications structure is not in place to coordinate the overall airshow.

It is recognized that individual teams and regions operate differently from each other, and there is no intent to mandate one standard, inflexible SOP for the whole country without regard for individual requirements. The goal of any cooperative effort between the communications and aviation sectors should be to recognize and utilize the flexibilities that the system allows.

The following pages show an example of how communications within the air operation was expanded to accomodate the increased requirements of one large area command, where several Air Attack organizations were working under one command. The close proximity of several teams operating within limited airspace, the fact that several teams were receiving retardant from one tanker base, and that tanker base was also serving adjacent incidents and neighboring forests required an impromtu restructuring of the communications planning, and this affected the Air Operations Structure.

The different types of arrows are not intended to infer a separate channel or frequency for each arrow; the arrows illustrate who the various positions in the structure were required to communicate with.

Example Scenario:

In this instance, it was decided that one overall air traffic control aircraft, the "Orbit Ship", was required to be responsible for the ordering of retardant from tanker base. Individual Air Attack Supervisors ordered retardant from the orbit ship, who in turn passed the order on to tanker base.

Incoming air tankers made initial contact with the "Orbit Ship", who assigned them a holding position (or altitude) and then passed them off to a lead plane, who was directed by the Air Attack ship for that area. After the drop was executed, the tanker exited the area on an assigned departure corridor to assure traffic separation and collision avoidance.

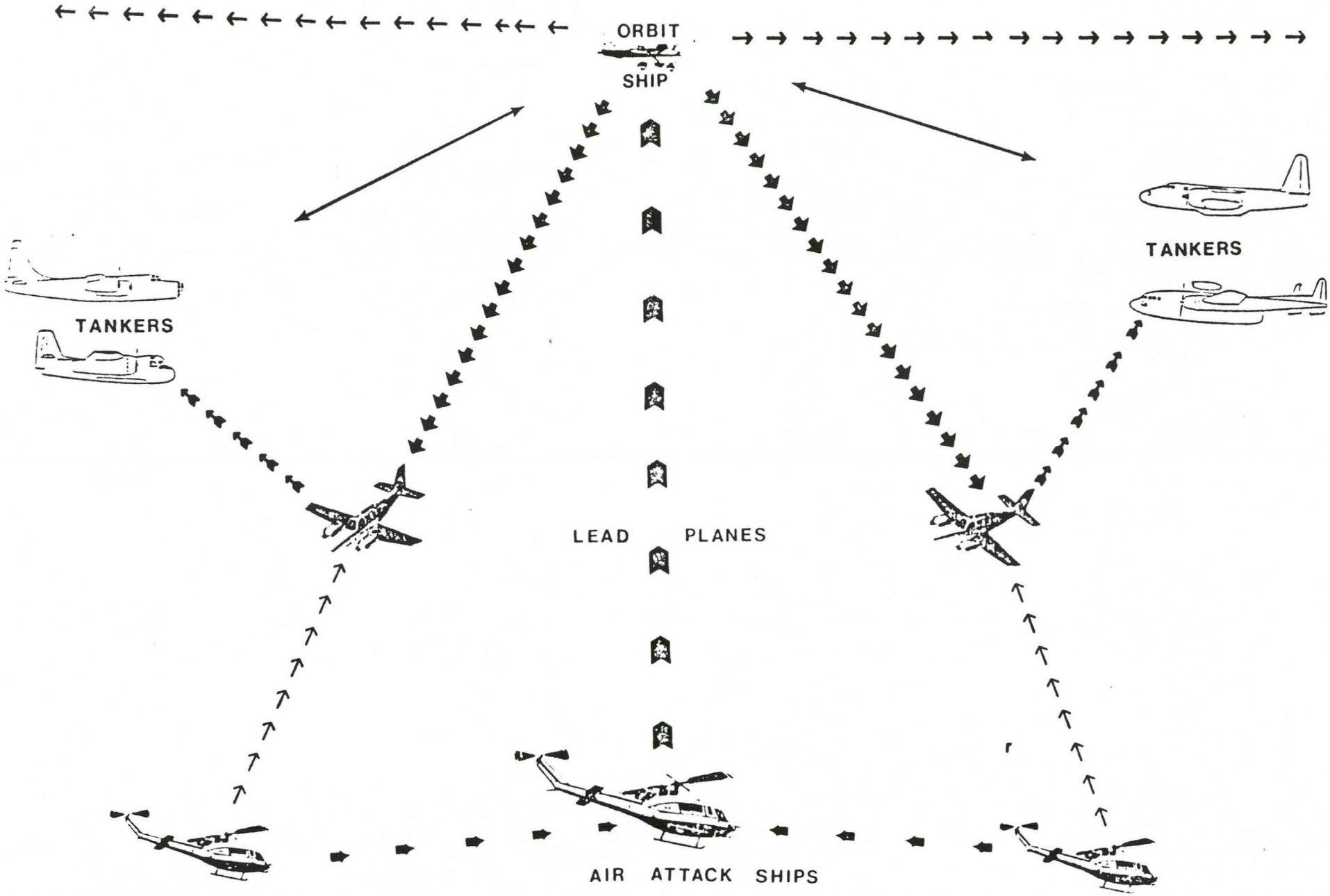
The key communications position in this structure is the "Orbit Ship".

Air Tanker Base dealt with only one party for the ordering of retardant, which simplified tanker dispatch.

Tankers were required to simply check in with one party before being picked up by a lead plane, which eliminated the need for them to identify which area of the command they were requested to drop on.

Individual Air Attack Supervisors were responsible for the tactical air operations of their own incident, with overall traffic control and retardant coordination left to the "Orbit Ship".

This complex an organization is not required in any but the largest of Incidents, and is not suggested as an SOP. It serves only to illustrate the flexibility and growth potential of the air communications equipment that already exists.



Example of Expanded Air Comm Plan - ICS

Appendix Item G

NFRC USAGE IN R-4 IN 1986

FIRE	SYSTEMS	DIVISION KITS	RADIO KIT	REMOTE KIT	P.A. SYSTEM	REPEATER KIT	VHF-AM 720Ch	VHF-FM 9600Ch
TWIN PEAK	1							
RE-RUN	1	1			1			
OAK GROVE	1	4	1	3	1	1		
FREDRICKSBERG	1	5			1			
GOODRICH	1	1			1		1	
SUMAC	1	1			1	1		
GARDEN VALLEY	1	1	2	1	5	1		1
LAVA	1	1				1		1
TUNDERBOLT	1	1						
HIGBY	1							
CLUB MEADOWS		1		3		1		
CHAOS		1				1		
DEADWOOD		1				1	1	1
IDAHO CITY COMP.		2				2		
WILLOW COMP.		3						
ABC		5				1		1
CHEESEMAN COMP.								1
MOWITCH								
BLM USE								5
ANDERSON CR.								1
CORRAL								1
	10	28	3	7	10	10	2	12
RADIOS	480	448						

NFRG USAGE IN R-4 IN 1986

FIRE	LOGISTICS SYSTEMS	REMOTE KITS	REPEATER KITS
CLUB MEADOWS	1		
CROOKED RIVER	1	1	2
FREDRICKSBERG	1		
GARDEN VALLEY	2	1	
GOODRICH	1		
OAK GROVE	2	1	1
RE-RUN	1		
TWIN PEAK	1	1	
	10	4	3
RADIOS	160		

NFRC USAGE IN R-6 IN 1986

FIRE	SYSTEMS	DIVISION KITS	RADIO KIT	P.A. SYSTEM	REPEATER KIT	REMOTE KIT	VHF-AM 720CH	VHF-FM 9600Ch
ABC								
ACE	2			1	1			
BLUE FIRE	1							
BUCKHORN	1	2		1				
CAMERON	2					2		
CORRAL	1							2
CRANE	1				1	1		
DARK CANYON	2	2			1	3		
DEARDORF		2	1	1				1
DELIVERY	1							
DESOLATION		2	2				1	1
CLEAR FIRE							1	
EUREKA								1
FRIZZLE				2	1			
GRANITE COMP.	1	3						
GROUSE	1	4	4		1	3	2	
HUCKLEBURY			1					1
JUNKENS					1	1		
JOSEPH COMP.								1
LAMB CHOP	1	3		1	1			
POWERLINE	1							
LOWER BEULAH	1							
SCALP	1			1				
SOUTH FORK	1	1		1				
SLASH BURN							1	
SOCO								2
TOWER COMP.	1	1		1		1		
WALLOWA COMMAND								1
17 MILE		1						
ROUND-UP DEMOBE.			1	1				
	19	21	9	10	7	11	5	10
RADIOS	932	336						

NFRC USAGE IN R-6 IN 1986

FIRE	LOGISTICS SYSTEM	REMOTE KITS	REPEATER KITS
BLUE FIRE	1		
BUCKHORN	1		
CAMERON	1		
CRANE	1		
DARK CANYON	1	2	1
DELIVERY	1		
DEARDORF	1		
DESOLATION	1		
FRIZZLE	1	1	
GRANITE COMP.	1	2	
GROUSE	1	1	1
LAMB CHOP	1		1
POWERLINE	1		
SCALP	1		
SOUTH FORK	1		
TOWER COMP.	1	1	1
	16	7	4

RADIOS 256

Summary of BLM/BIFC Equipment used during the '86 Fire Season.

I. BLM/BIFC procured early in the 1986 fire season a pair of L Band Satellite earth terminals. These Terminals are manufactured by Telesystems and are designed primarily to provide voice communications from a remote location to a hub station or to another earth terminal. A secondary application allows four wire audio to be connected, hence a user supplied modem can transfer data over the system. A node, or earth terminal, is extremely portable and appropriately ruggedized. A node, when packed for transportation, is the size of two normal suitcases. Antenna and all components breakdown and fit comfortably in the two cases. The total weight is 165 lbs. The node can easily be put into operation, normally within twenty minutes. A CUL, CUS, or ET can easily setup and operate a unit with minimal training (1 day). Its portability and user friendliness are its greatest attributes.

The cost of procuring an earth terminal is approximately $40,000. This includes the commissioning costs, factory representation to facilitate initial startup, and a maintenance school for one ET per unit purchased. The cost of operating a unit is based on a flat charge of node to hub operating time, the user paying only when using the satellite. The charge is $10 per minute of operation, incremented in tenths of a minute. This includes the long distance charges from the hub to the commercial phone as well as the transponder costs. This method of operation tends to be at the mercy of the commercial phone circuits available. Problems encountered are poor audio quality, possible grid lock, and busy phone curcuits at the dispatch. The cost of operating from node to node is the cost of two node to hub calls, or $20 per minute. The rational being twice the transponder usage because all calls are routed through the hub station. Operating node to node full duplex is actually using four channels on the satellite. Node to node operation provides the best audio quality as well as fast and reliable communications.

Using this system for data tranfer is awkward but usable. Due to budgetary and ADP approval constraints, the modems we used with this satellite system operated at 1800 baud. The GRiD computers are capable of far greater speeds as is the satellite equipment. This satellite equipment should be capable of handling speeds of 4800 baud, and possibly 9600 baud with careful selection of the modems. The intended purpose of this equipment was voice communications, hence the difficulty in utilizing the data transfer mode of this equipment; you must manually place the call, manually tranfer control to the modem, and finally manually disconnect the call. Every message, form, or resource order must have this manual manipulation accomplished just to get transfered from one node to another. The disadvantages, in terms of connect costs, for utilizing this communications media for on-line processing is obvious.

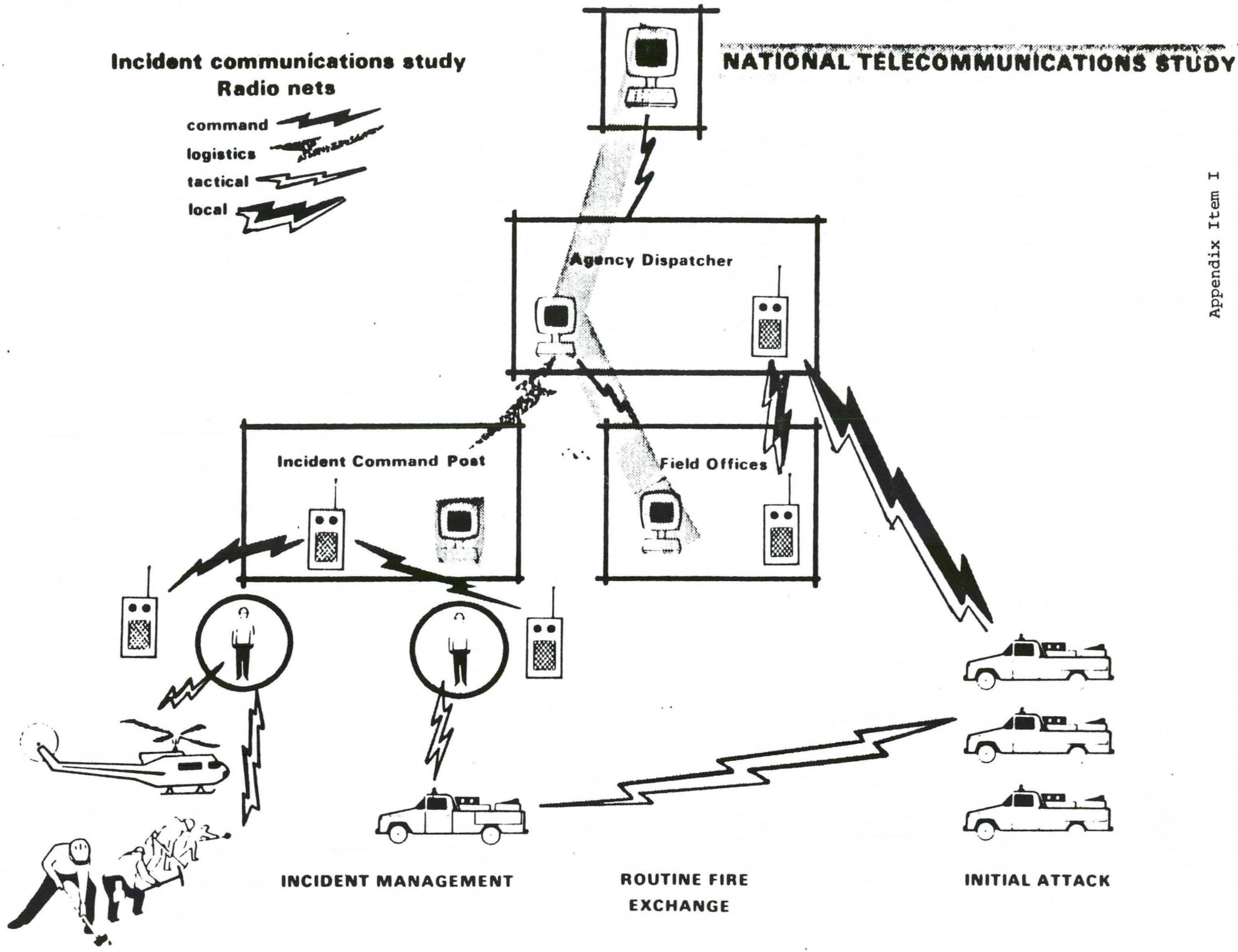
The expandability of this system (to multiple channel operation) is planned but not available. The indications are that an

additional suitcase will be added for each additional channel. Other L Band manufacturers are already getting their systems approved and ready for market. This competition should produce many favorable results. INMARSAT has been approached concerning the high cost of transponder time. They have expressed a willingness to make concessions, however nothing has been initiated at this time.

The applicability of Telesystems earth terminals is worthy of note. The portability means that this system and a Honda 300 generator can be loaded into a Bell 206 helicopter, flown to any site, and communications can begin 20 minutes after landing. This communications can be sustained until more cost effective radio or satellite systems can be brought in and installed. This is a strong consideration as a first line of defense. Frequency conservation, especially when dealing with an area command, can be hightened by satellite usage instead of already congested UHF logistics frequencies. The ability to communicate directly with the Service Center (node to node), bypassing the busy phone circuits and radio nets, means fast and reliable communications when you need it.

In consideration of all pros and cons of L Band Satellite Communications, totally discounting this system as an operational communications media may prove to be a mistake at some time in the future.

II. In response to requests from the field for any available satellite communications to support the multiple area commands during the '86 fire season, BLM/BIFC leased a Ku Band Satellite system from Skyswitch Satellite Corp.



Appendix Item I